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PC MAGAZINE

FIRST LOOKS

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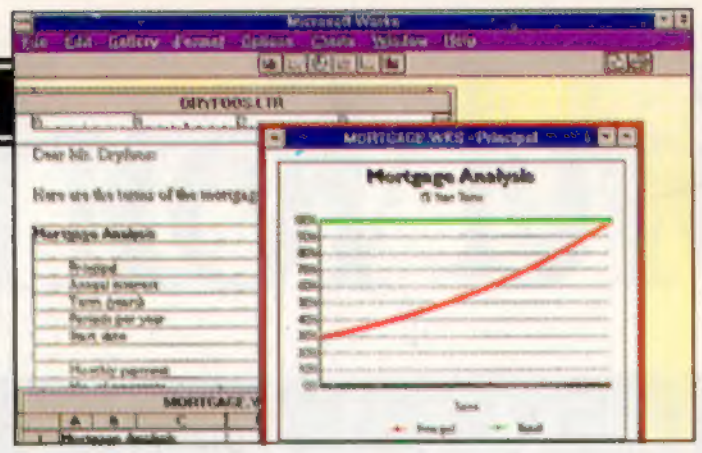

FREE UTILITY

Squeeze Even More Memory Out of DOS 5.0 With UMBFILES

FIRST LOOKS

Low-Cost LANs: Novell's NetWare Lite Takes On LANtastic

NOVEMBER 26, 1991 THE INDEPENDENT GUIDE TO PERSONAL COMPUTING VOLUME 10 NUMBER 20

8TH ANNUAL

Printer BLOCKBUSTER!

We Review 106 Printers

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PC MAGAZINE EDITORS' CHOICE
October 29, 1991
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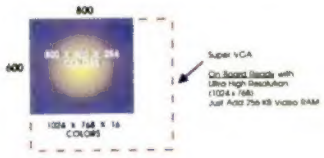
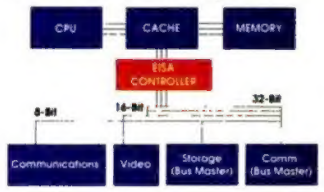
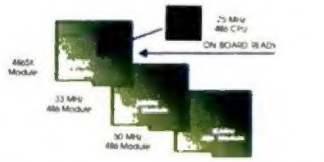


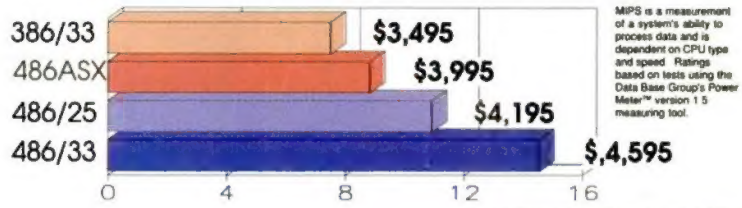
EISA = Increased Performance



A Family of Cost Effective CPU Upgrades



BusinessVEISA Bundles CPU Performance & Price



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CIRCLE 291 ON READER SERVICE CARD

Inside

Dot matrix printers are supposed to be in decline, but somebody forgot to tell Epson, Okidata, Star Micronics, and company. Hewlett-Packard has a stranglehold on the laser printer market, but you can't convince IBM, Panasonic, QMS, Texas Instruments, Kyocera, and Digital Equipment Corp. (yes, even DEC) that there is no market share to be gained. Welcome to another *PC Magazine* printer issue, and another hundred printers. This is our eighth annual fall review of all the past year's new models.

For 1991, we've collected 45 laser printers, 47 dot matrix printers, 5 ink jet printers, and 9 color PostScript page printers. That's 106 units all told—819 printers in the eight-year history of what we internally call Project Printers.

Printing Heads: Rist, Flynn, and Zulich. Four-color photos printed by the solid-ink color PostScript Tektronix Phaser III PXI.

Manager of Project Printers for the third consecutive year was our associate editor for hardware feature stories, Mary Kathleen Flynn, working this year with PC Labs project leader Michael J. Zulich, who supervised the testing, and staff editor Oliver Rist, who line-edited many of the half-million words of manuscript.

One could argue long and hard over which segment of the PC industry best supports the truism, "There is no constant but change." *PC Magazine*'s hardware team would argue that printers represent, at the very least, one of the most highly visible proofs of change. Says Flynn, "Most everyone remembers the first generation of HP LaserJets, which were huge, weighed a ton, cost $3,500, and were not much more than quiet daisy wheel printers. Today you can buy a great laser printer for under $1,000, and you'll find the very cheapest for as little as $600." Most laser printers have scalable fonts this year. Many have speedy RISC processors.

Speaking of change, we've gone from one laser printer in the first printer issue to 45 page printers this year—nearly half the field. With their increasing numbers comes stratification; we've created a separate category, shared printers, for the 10 higher-speed network-oriented page printers (12 ppm and up) like the LaserJet IIISi and QMS PS-2000. Ink jets, which appeared mired in a low-speed, high-consumables cost squeeze between lasers and dot matrix printers, have gained new life, especially with the advent of speedy, affordable units that can produce passable color for business users. And we've added a section for color PostScript printers, the $7,000 to $15,000 devices whose market is expanding rapidly from ad agencies and design studios to mainstream offices. Even dot matrix printers have been given new twists from Panasonic and Epson: ultraquiet print modes and scalable fonts.—**Bill Howard** ■

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November 26, 1991

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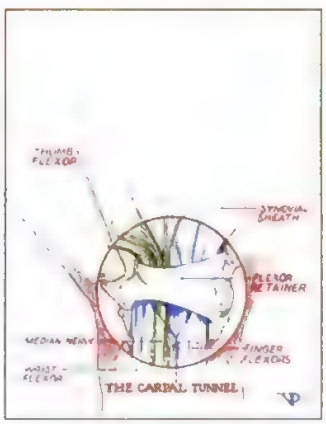

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Letters

EDUCATION: THE FINAL FRONTIER

As an educator who works with all types of computers, I could not agree more with William F. Zachmann's column "Education: The Final Frontier" (August 1991). But there is one key factor he omitted: education of the educators.

If the educator in the classroom hasn't any knowledge (or worse, doesn't *want* to have any knowledge) of all the good educational software out there, then the students will not be exposed to it unless it is used in their homes.

The recent school budget cuts throughout the country are not a good sign for the educational sector. The thought of raising taxes is repugnant to the average taxpayer. But the first key turned in the lock must be the one to train the people who do the training.

Arthur B. Fay
Fredericksburg, Virginia

Zachmann forgot to oil the hinge of the educational door. Unless the educational system embraces computer technology as a primary tool at all levels, the rusty hinges of the door we are attempting to unlock will surely impede our opening it more than just a crack.

We must train those who are training our next generation to embrace this technology and use it on a daily basis.

David R. Hill
Philadelphia, Pennsylvania

Many public-school teachers, administrators, and professors of higher education fear the impact that computers might have on the security of their positions. A large number of these people are intimidated by computers and fear that their inability to cope with computerization will be exposed.

I hope that Zachmann is right about computers and education for the sake of our children, who, incidentally, seem to know more about computers than 95 percent of their teachers.

James H. Hunt
Boise, Idaho

Readers cry, "Educate the educators!"

$198 VS. $5.95?

In John C. Dvorak's Inside Track column (September 10, 1991), he urges everyone from homeowners to corporate network administrators to spend $198 for an Accutest II (a wiring integrity tester). Radio Shack has, for several years, been selling a 120VAC Grounded Outlet Analyzer (22-101), currently listed at $5.95. This device will show open ground, open neutral, open hot, hot/ground reversed, and hot/neutral reversed.

These are the only functions mentioned in Inside Track that the Accutest performs, but at that price I sure hope it does more. You can buy 33 Radio Shack devices for the price of one Accutest II! While you don't get a lifetime guarantee with the Radio Shack unit, at its current price who needs one? I highly recommend this device to anyone who must plug anything into an AC outlet.

Joe T. Rawlins
Groveland, Massachusetts

PC MAGAZINE The Accutest II also looks at impedance faults and other anomalies.—*Ed.*

NOTEBOOK NECESSITIES

I find that a basic piece of information is often missing from your notebook computer reviews. You constantly stress that the computers must be configured in such a way to make portability easy, and you've gone so far as to dismiss computers that don't have an internal modem slot.

So why, why, why is it that your features table has a line entry for FCC Class B certification but no item that mentions whether or not the computer has a handle or at least comes with a carrying case?

What good is it if a computer is small and light if there's no way to carry it with you? The "rugged ridge" that some of the notebooks have doesn't help too much when the temperature is above 70 degrees or you're running for a cab.

So get real, and tell us who has a handle, and/or a carrying case (and if it's optional or included). Real users want to know.

C. Raphael Poliakoff
Bellevue, Washington

In the flood of battery-powered notebooks during the past year, the manufacturers are missing what is truly needed. Forget about the battery—unless it can last at least 10 hours. A battery-powered computer is like a battery-powered car: a good idea but not practical in real life.

Give us an AC-powered notebook with the power supply built-in, 4MB of RAM, and a 60MB hard disk standard; let it be compatible with every monitor, and give us a practical carrying case, standard!

Mike Yang
Tustin, California

DEATH, TAXES, AND STATISTICS

In response to Sander Schimmelpenninck's complaints (Letters, August 1991) about statistics being a "dull and arcane craft" with "formulas as old as meat and potatoes": Many of the formulas are old (have been in use a long time) because they work! And I am sorry to tell you this, but a statistics program doesn't have the

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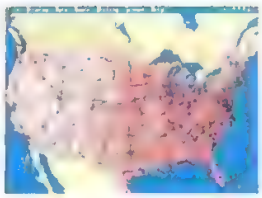

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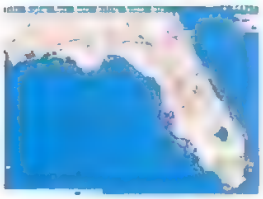

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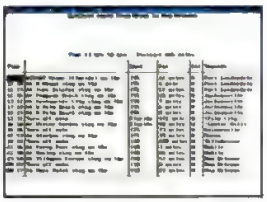

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CIRCLE 484 ON READER SERVICE CARD

Letters

ability to tell you which analysis is appropriate for your particular question; for that *you* have to learn statistics.

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David M. Polcyn
San Bernardino, California

DROPPING THE BALL

I am always glad to read the First Looks reviews in your magazine. The article on Software Publishing Corp.'s *Harvard Graphics* 3.0 (August 1991) fell short of the mark, however. It expressed how good the new product is and described all of its new features. Unfortunately, the article did not point out which features were dropped from the old version.

The new version dropped its support for the film recorders it had supported in Version 2.3. This will prevent me from adopting the new version because I cannot invest in software that makes my hardware obsolete. Come on, SPC, you dropped the ball.

Verlin Cross
Woodbridge, Virginia

IT MUST BE THE MOON: A POTPOURRI OF READER MAIL

A new high-tech disease has been identified called "ALTS." ALTS (Airline Lunch Tray Syndrome) is a serious disorder that affects designers of laptop computers. Any laptop design engineer who contracts ALTS will become obsessed with designing any new laptop computer so that it will fit on an airline lunch tray.

Until the discovery and identification of ALTS, the cause of tiny inconvenient laptop keyboards was unknown. The only known therapy for ALTS at this time is an intensive program that requires the infected designer to observe many, many people using laptops on surfaces other than airline lunch trays.

Orville Jenkins
Roanoke, Texas

With the Flash EPROM BIOSes now coming out (on machines such as the Dell 450DE), the threat of a new form of virus appears. Since the BIOS can be changed from within the software, what is to keep virus programmers from changing the very heart of the machine? Scary!

David Duani
Stanardsville, Virginia

I don't understand what is happening at Borland International. I bought Turbo C++ in July 1990. Then one year later, I was given a deadline of September 8, 1991, to either upgrade to Borland C++ or lose the privilege of upgrading.

Does Borland expect its products to only last a year? While the upgrade price is good, the suggested retail price of $495 is a lot for the home user. That's sad, because Borland has long been a refuge for the home user who wants products of the highest quality for a very fair price.

I'm really afraid Borland is going the way of Microsoft: It's losing contact with the people who put it in the position it now enjoys. How long will users put up with this incessant upgrade mania and with disproportionate cost increases? What are users to do?

Joe Noble
Littleton, Colorado

Now that Microsoft has officially abandoned OS/2, we should expect to see some really great OS/2 products come out of Microsoft in about a year or so.

Michael Mast
Agoura Hills, California

In *2001: A Space Odyssey*, HAL says that he was activated at the HAL plant in Urbana, Illinois, on January 12, 1992. Since that date is almost upon us, I wonder if anyone has heard anything about a secret project out there. Do you think we'll make it in time? Could we at least get a cyborg with an Austrian accent?

By the way, Arthur C. Clarke says that HAL stands for Heuristic/ALgorithmic, and that he would have changed the name if he

> In *2001: A Space Odyssey*, HAL says that he was activated at the HAL plant on January 12, 1992 . . .

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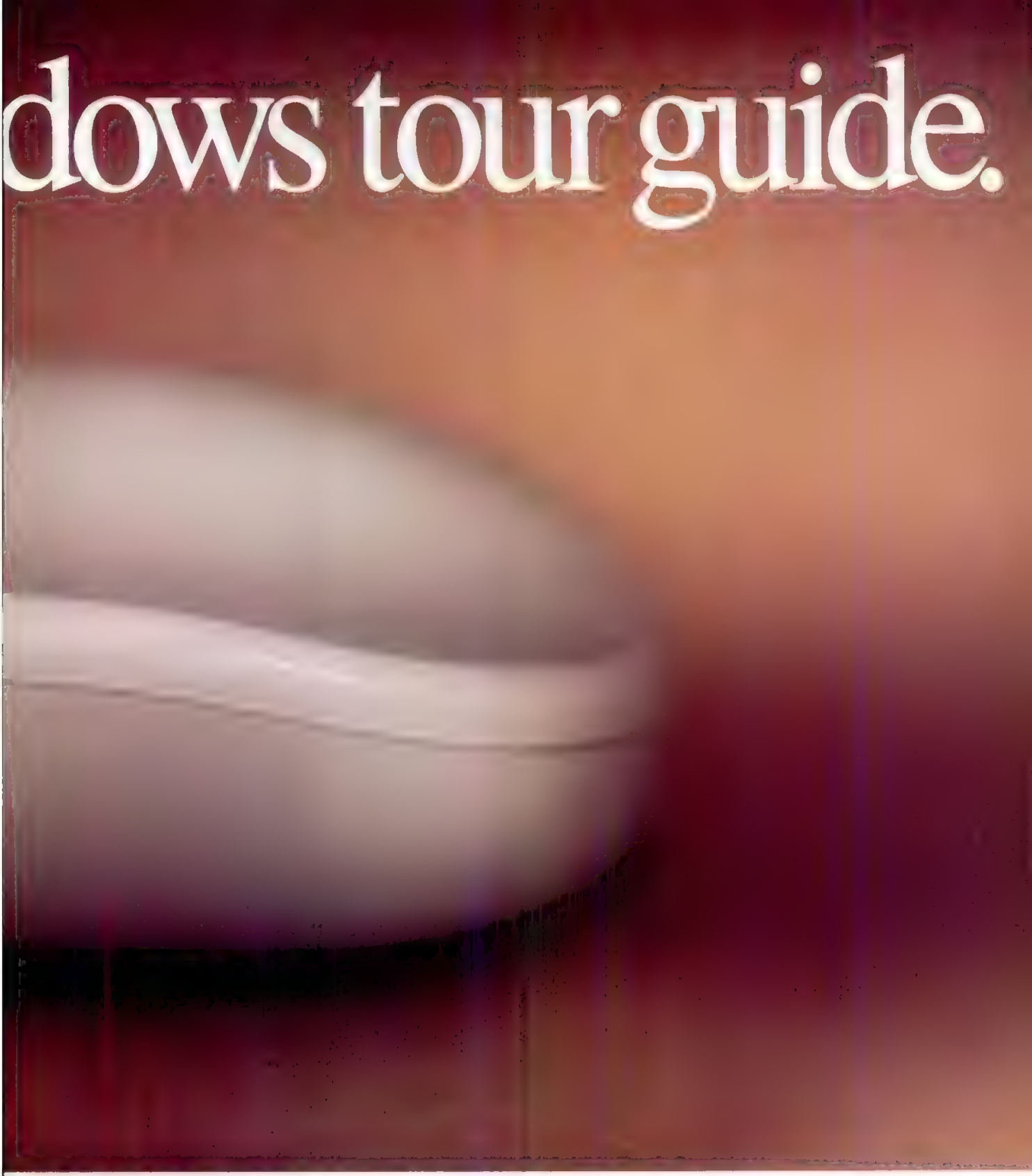
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CIRCLE 264 ON READER SERVICE CARD

had noticed the one-letter-before-IBM "coincidence" before the movie was made.

Tom Del Rosso
Floral Park, New York

What I have been reading in your magazine and elsewhere about the increasing arrogance of Microsoft Corp. came home with finality yesterday. I had written the people at Microsoft a three-page letter

> Hey designers! It's not too late to improve the CD format . . . is it?

concerning a product defect. I received a form letter saying they couldn't help me. Please understand that I wasn't asking which side of the floppy disk goes up. It was a technical problem.

The contrast with WordPerfect Corp. could not be more vivid. When I had a problem with the printer driver for the HP LaserJet III, the WordPerfect staff not only answered their 800 number (my employer blocks 900 numbers like Microsoft's), but they read my letter, called me back on their dime, and sent a replacement driver by the next mail.

I suppose that if you are a corporation that can thumb your nose at IBM, you will not hesitate to do it to your users, too.

Joseph H. Noggle
Wilmington, Delaware

I agree with William F. Zachmann. I think OS/2 will eventually succeed in the marketplace once the migration from the DOS/*Windows* combination becomes painless and beneficial. I must also agree, at least in part, with Jeff Snyder (Letters, September 10, 1991): Zachmann seems to be obsessed with OS/2. Please, Will, leave it alone for a while and write about something else.

Terry A. Griffin
Seattle, Washington

To all Bill Machrone's wishes for a better designed compact disk (August 1991), I would like to add one: I wish the designers of the CD had included a protective cover similar to those on 3.5-inch floppy disks. Hey, designers! It's not too late to improve the CD format . . . is it?

Marc Wassill
Airdrie, Alberta, Canada

I am an independent computer consultant in Japan, specializing in ISA/EISA machines. I initially needed to purchase three 486/33s with EISA/SCSI caching disk controllers. I was planning on buying fifty more if the three worked out for my project. I faxed letters to 18 American suppliers, asking for price quotes. (I couldn't contact some companies because they only had 800 numbers, which cannot be dialed from Japan.) Even more disturbing, only six of the eighteen companies responded, and some of those sent me a price sheet for an ISA unit with an IDE hard disk!

America makes a great deal of noise about its trade deficit with Japan. After my recent experience, I'm surprised it's not bigger! If American companies aren't interested in selling Japan the good stuff, how can anyone complain when Japan isn't interested in the poor-quality stuff?

Jackson M. Garrott
Omura, Nagasaki, Japan

CORRECTIONS & AMPLIFICATIONS

The BBS number for Searchlight Software ("Bulletin Board Software: Tools for Wide-Area Communications," September 10, 1991) should have read 516-689-2566.

Since the review "Access Servers: Dialing Up the LAN" came out (September 10, 1991), LANMaster IncomServ (as well as *OutcomServ* and *FaxServ*) has been acquired from Vestra-Subco by ComWare Corp. It can be reached at Enterprise Plaza #204, 13915 Burnet Rd., Austin, TX 78728; 512-244-9091.

HOW TO WRITE TO PC MAGAZINE

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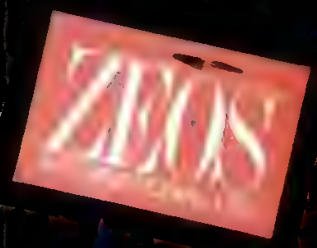

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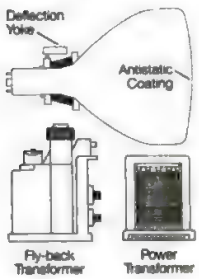
There are basically two kinds of high-resolution Super VGA color monitors. Those that are interlaced. And those that are not.

Now, a picture that's interlaced may sound like something you'd want. But interlacing is merely a way to use the same old electronics to produce higher-resolution monitors. With interlacing, the monitor's electron beams can only refresh every other line of pixels (dots) on each pass of the screen.

Understandably, this shortcut causes the screen to flicker, creating eyestrain.

"Flicker Free" monitors, made with longer-life phosphors, are an attempt to solve this problem. They slow the flicker, but produce other visual side-effects, such as "ghosting."



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Samtron's new VLMF monitors use a special shielding on the deflection yoke, an antistatic CRT coating, a special type of fly-back transformer, plus a power transformer specifically designed to reduce magnetic emissions.

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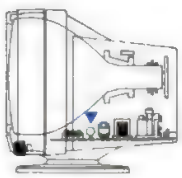

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CIRCLE 296 ON READER SERVICE CARD

by
Gus Venditto

Pipeline

A Look at the Trends Shaping the Personal Computer Market

Can Lotus Become A Leader in LAN Messaging Standards?

Everyone's talking about messaging standards for networks, and now Lotus Corp. is trying to take the lead in setting them.

A messaging standard is the missing link between ordinary applications and transport services such as Novell's *MHS*. It lets you send a spreadsheet to one of your colleagues without quitting the spreadsheet, booting up LAN mail, and attaching the file to a message.

The new standard is called OMI (Open Messaging Interface). It was designed to give *Lotus 1-2-3 for Windows*, *cc:Mail*, and *Lotus Notes* the ability to exchange messages and is a cornerstone of Lotus's development efforts in recent months.

Now Lotus is encouraging others to make their applications comply with OMI. Initially, it has obtained a commitment from Apple to include support in a future version of System 7. And IBM has said that future versions of OS/2 and OfficeVision/2 will include OMI technology. Both Apple and IBM are currently contributing ideas to the development of OMI.

The people at Novell have said that the standard does not conflict with anything they are doing and, as market demand requires, they will support this messaging standard along with MHS, SMTP, SNAD, and X.APIA.

You can expect to see all of Lotus's *Windows* products with OMI features. But even though leading software developers are eager to find a good messaging standard to adopt, Lotus will have to do an incredibly good sales job to overcome its competitors' reluctance to become a partner with Lotus in building standards.

Lotus Fixes Problems With 1-2-3 for Windows

Without changing the version number, Lotus says it has fixed some of the problems early users of *1-2-3 for Windows* were experiencing, including the partial screen redraws. Copies of the program that have been shipped since late September have the corrected code.

If you experience problems with a new version of the program, contact Lotus for information about fixes.

Computer Associates Buys dBFast and PHIPS

In its quiet way, Computer Associates is building a grand strategy for full interoperability across a wide range of Unix and mainframe systems, with some low-end PC products as entry points.

In recent months, Computer Associates has introduced a low-

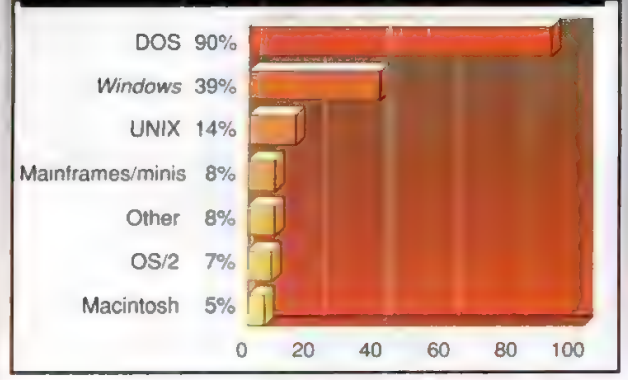
CONTINUES ON PAGE 30

SURVEY: APPLICATION DEVELOPMENT TRENDS

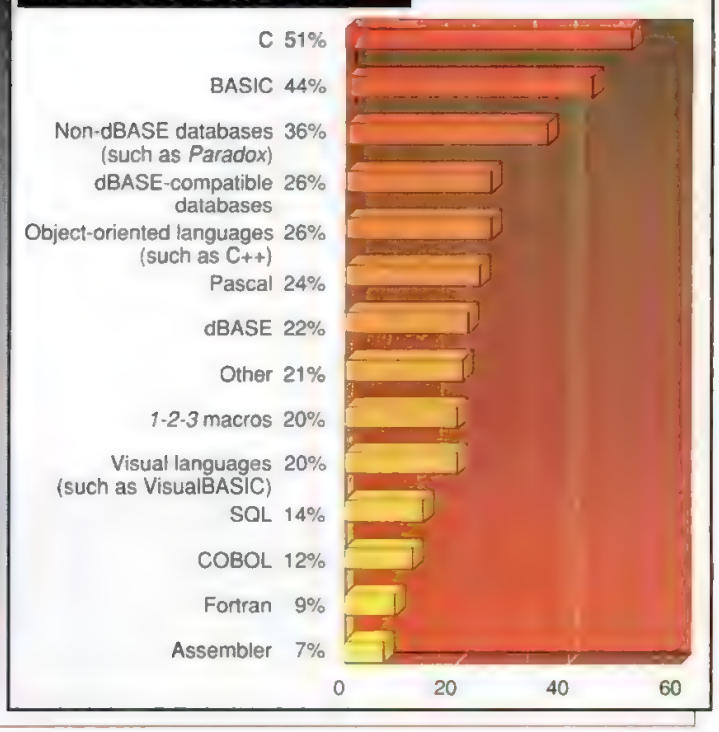
The avalanche of new products may make it seem that *Windows* has overtaken DOS. But a recent survey of callers to PC MagNet demonstrated that development for DOS is alive and well.

When we asked 1,143 callers to PC MagNet about applications development, we found a general split among applications developers on many issues—except the platform. *Windows* may be growing in popularity, but it has a long way to go before it overtakes DOS.

For which environments do you develop applications?



Which languages do you currently use in developing applications?



CONTINUED FROM PAGE 29

end *Windows* accounting program (*CA Simply Accounting*) and ported the Cricket family of Mac charting programs to *Windows*. And it has just acquired two of the more interesting new technologies.

PHIPS, the 24-bit color-retouching software that was a *PC Magazine* "Best of 1990" product, has become *CA-PHIPS*. *dBFast*, the first *dBASE*-language compiler for *Windows*, was acquired from GenSoft.

Both products were acquired in full, including key programmers on the development teams. Computer Associates will be providing support to anyone who registered the product in the past.

HP's New Wave and Microsoft's OLE Come to Terms

The Object Linking and Embedding (OLE) specification that Microsoft has published for *Windows* has been a potential problem for HP's *NewWave* environment, which already made some of these file-linking features available to *NewWave*-compatible *Windows* programs.

Now HP and Microsoft have agreed to work together so that *NewWave* and the OLE specification can coexist, with the possibility that there will be some overlapping of the two systems.

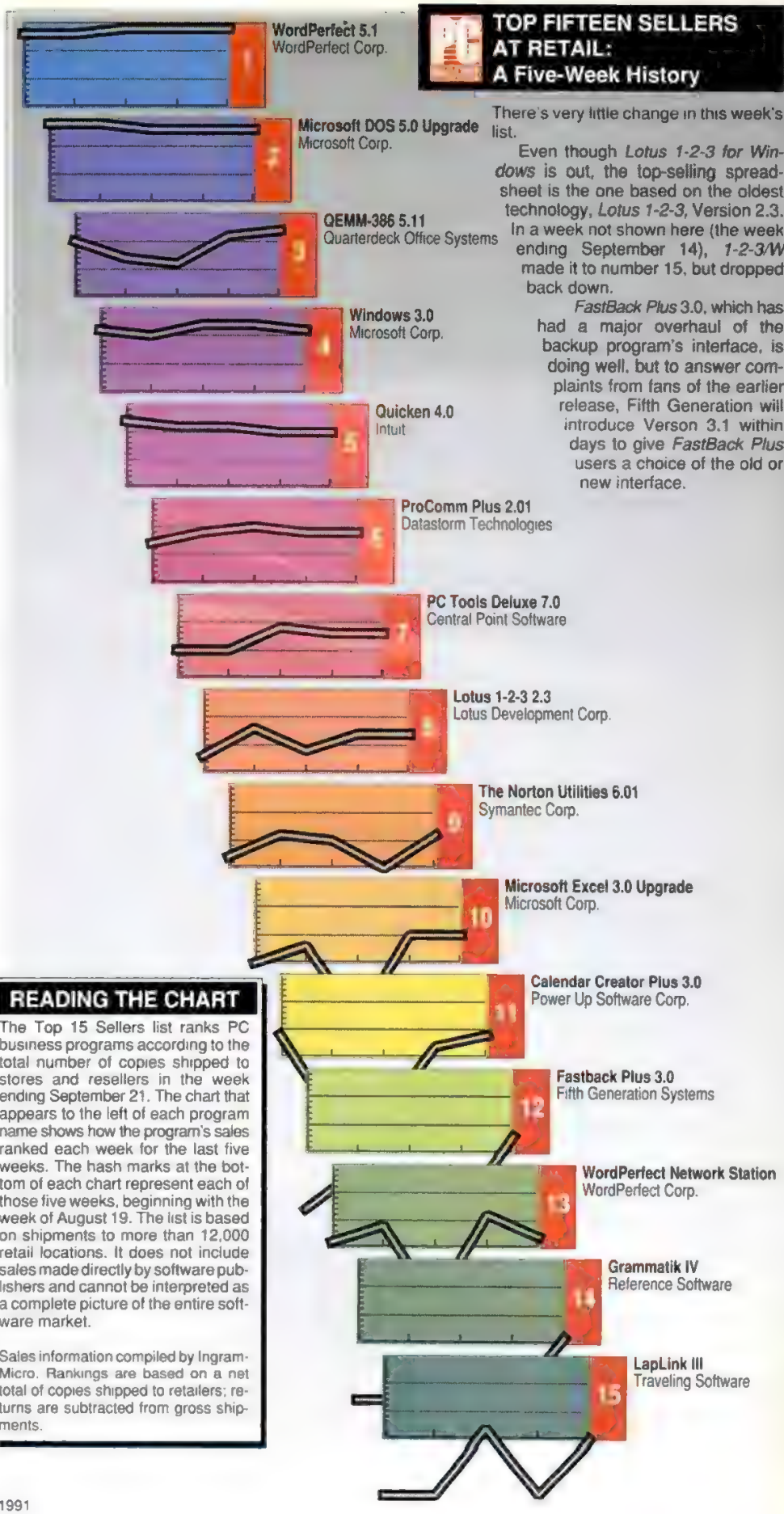
Actually an extension of the *Windows* Clipboard, OLE lets a single document contain live links to several other *Windows* programs.

NewWave had a similar data-embedding system, which was based on underlying macros.

Applications have to access these features specifically. The HP-Microsoft agreement means that in the future, developers will be able to write to just one specification instead of both.

Although OLE will first be seen in *Windows* 3.1 applications such as Write and Paintbrush early next year, OLE is not version-dependent, and programs that add OLE features will theoretically be able to link files with other OLE programs in Windows 3.0. ■

TOP FIFTEEN SELLERS AT RETAIL: A Five-Week History



There's very little change in this week's list.

Even though *Lotus 1-2-3 for Windows* is out, the top-selling spreadsheet is the one based on the oldest technology, *Lotus 1-2-3*, Version 2.3. In a week not shown here (the week ending September 14), *1-2-3/W* made it to number 15, but dropped back down.

FastBack Plus 3.0, which has had a major overhaul of the backup program's interface, is doing well, but to answer complaints from fans of the earlier release, Fifth Generation will introduce Verson 3.1 within days to give *FastBack Plus* users a choice of the old or new interface.

READING THE CHART

The Top 15 Sellers list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending September 21. The chart that appears to the left of each program name shows how the program's sales ranked each week for the last five weeks. The hash marks at the bottom of each chart represent each of those five weeks, beginning with the week of August 19. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a complete picture of the entire software market.

Sales information compiled by Ingram-Micro. Rankings are based on a net total of copies shipped to retailers; returns are subtracted from gross shipments.

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First Looks

Hands-on Reviews of the Latest Products

Heavyweight Champ Goes Lite: NetWare Takes on LANtastic

HANDS ON
by M. Kevin Thompson

In a move aimed at winning a lightweight crown in the LAN market, Novell's new *NetWare Lite* takes on Artisoft's *LANtastic*. *Lite* is spunky, but weighted down by copy protection and the lack of sophisticated disk caching; it can't compete with *LANtastic*. Still, *Lite*'s potential to make a smooth glide into heavyweight Novell server environments could make it a popular competitor.

At $99 per node, Novell targets *NetWare Lite* at the first-time network user who wants to share DOS-based PC resources like programs, files, and printers. Once you add network adapters, the price is $200 to $450 per node. *Lite*'s cost-per-node is fixed; other products work on a sliding-cost scale. But compared to *LANtastic*, *NetWare Lite* falls in the middle price range for a three-to-four node network, and quickly grows expensive in installations with ten or more nodes.

NetWare Lite requires about the same amount of memory as its competitors. A client PC gives up about 27.5K RAM to the software; the server software takes about 49K. You'll want to run a cache program in any PC acting as a server.

Novell's earlier entry-level product, *NetWare ELS*, sold well, but it was, in many ways, crippled. *NetWare Lite* does better on all counts. Users running *NetWare Lite* can access other *NetWare* 2.*x* or 3.*x* servers simply by adding the appropriate NET*x*.COM shell program to their PCs. *NetWare Lite* users can also MAP drive letters to *NetWare* 2.*x* and 3.*x* servers while maintaining their connections to the *NetWare Lite* network. (*LANtastic*'s AI [Adapter Independent] BIOS offers a

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NEC ProSpeed 486SX/C: 486 power, 256 colors, and luggable 44

WordStar for Windows: It's *Legacy* plus *Wordstar* keystrokes 48

QuickC for Windows: A graphical C 49

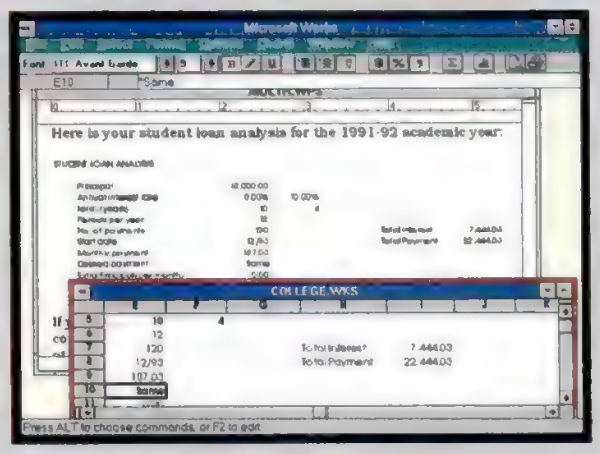
Microsoft's "Solutions": Low Price + Ease of Use = Mass Appeal

Thinking small is now a big business strategy. Microsoft's new trio of Windows *apps*—Works, Money, *and* Publisher—*targets the previously disenfranchised: small business and home users, the technology overwhelmed, and the frugal.*

Works for Windows

HANDS ON
by Rock Miller

Microsoft Works for Windows—the centerpiece of Microsoft's new Solution Series of low-cost *Windows* applications—owes a lot to its popular forerunner, *Microsoft Works*. Like the DOS-based integrated package, *Works for Windows* supplements a reasonably full-featured executive word processor with simple spreadsheet, database, and charting facilities. (*Works for Windows* does not include a communications module, relying on *Windows* Terminal instead.) And like the DOS version, it comes at a price that makes it particularly attractive to home and small-business users: $199.



***Works For Windows* combines word processing, spreadsheets, databases, and charting features. It relies on the *Windows* Terminal for its communications module.**

Though the point of *Windows* is to integrate applications, getting all the basics in a single package from a single vendor has its advantages. All of *Works for Windows*' components share a similar multiple document interface (MDI), and its common design features, which include an icon bar for text formatting and an excellent page preview function, give them a consistent feel. The result is an integrated package that's easy to learn and productive to use.

The heart of *Works for Windows* is its word processor, which is similar to *Windows* Write but has been greatly improved with an updated icon-bar interface, footnotes, a 100,000-word spell-checker, and a thesaurus with 190,000 synonyms. A Bookmark feature that lets you mark your place and return to it instantly is a real productivity enhancer. Unfortunately, the Note-It function, which lets you insert nonprinting notes, clutters up your document with a

CONTINUES ON PAGE 38

NetWare Lite

CONTINUED FROM PAGE 35

similar approach.)

NetWare Lite provides a menu-driven and command line program called NET to set up the sharing and use of network services. But Novell complicated administration with a copy-protection scheme that forces you to install *NetWare Lite* from a different disk for each computer. If two computers on the network have the same copy of *Lite* installed, both computers periodically report a "License Violation" on the screen. This form of copy protection imposes a long-term management effort because someone must keep track of the pairing of each installation disk with each computer. *NetWare Lite*'s administrative commands are more equivalent to *LANtastic*'s than to *NetWare*.

In addition to the standard file and print services, *NetWare Lite* includes simple messaging and audit logs. Auto-reconnect, the most useful of the new features (one that is conspicuously absent in *NetWare* 2.*x* and 3.*x*), means you don't need to reboot a client computer if the server goes down. When the server comes back up, *NetWare Lite* establishes the preexisting connections. This feature is particularly important in peer-to-peer networks where anyone can hit Ctrl-Alt-Del on their own PC, even if it's acting as someone else's server.

Lite's security is simple but effective. "Full rights" lets users create and delete files at will. "Read-only" allows users to run programs, but not delete them; "No access" restricts users even from viewing files with DIR. While security is simplified, the features are less robust and flexible than *LANtastic*'s.

By using open datalink interface drivers for the network interface cards, *NetWare Lite* can operate over a variety of LAN adapters. Users can switch to more powerful versions of *NetWare* without swapping device drivers and hardware.

NetWare Lite includes a NetBIOS driver that lets people use network versions of applications and communicate with other NetBIOS nodes on the same network. Like *NetWare* 2.2 and 3.11, *NetWare Lite* maintains compatibility with most network-aware software by using IPX as the communications protocol. Some *NetWare*-specific programs, however, will not operate correctly because *NetWare Lite* does not include the Bindery.

Throughput is good, but *Lite*'s doesn't have the punch of *LANtastic*. *LANtastic*'s superior performance can be attributed to it's caching and its tight integration of hardware and software. *LANtastic*'s LANcache holds the data in disk sectors around previous requests, caches writes, and optimizes disk drive activity. *NetWare Lite*'s rudimentary caching service is no match. *LANtastic* can also take specific advantage of the Artisoft hardware.

In PC Labs tests, *NetWare Lite* moved data at 460 kilobits per second on a PC performing a mix of reads and writes while four other PCs were working on the same server. In the same scenario, *LANtastic* registered 625 kbps and the level of network activity was higher.

We ran a less formal test with the server running *WordPerfect* as a foreground application and the client PCs exercising the server's hard disk. We noticed a slight delay in the screen redraws as we scrolled down the screen under *Lite*; *LANtastic* had no noticeable delay. But both networks provided reasonable use of *WordPerfect* on the server.

NetWare Lite is a solid entry in the peer-to-peer market. It's got little in common with its big brother's command set and the copy-protection scheme is an imposition, but its simple features and smooth progression to *NetWare* 2.*x* and 3.*x* might be adequate bait. ■

FACT FILE

NetWare Lite, Version 1.0
Novell Inc., 122 East 1700, South Provo, UT 84606; 800-638-9273, 801-429-7000.
List Price: $99 per node.
Requires: 27.5K RAM Client, 49K RAM Server, DOS 3.*x*, network cards with ODI drivers.
In Short: A peer-to-peer LAN operating system with good, not great, performance and a rich but not overwhelming set of features.

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BENCHMARK TESTS: NETWARE LITE

HOW WE TESTED

We ran the PC Magazine LAN Labs benchmark tests using thin Ethernet cabling, Artisoft AE-2 adapters, a 20-MHz 386 computer as the server, and four client PCs equipped with 286 and 386SX processors.

The graphs juxtapose the scores on the Workstation Throughput Evaluation test and the Hard Disk Access Load test. This clarifies the relationship between the output of the PC running the throughput tests and the overall work done on the network.

WHAT THE NUMBERS MEAN

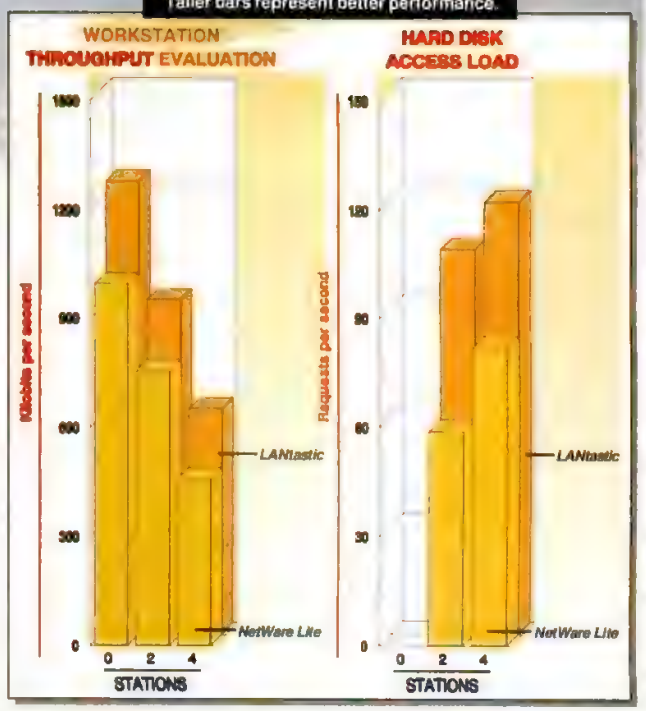
Performance of LAN operating systems is determined primarily by two factors: transport-layer software and a disk cache. *NetWare Lite* uses IPX and *LANtastic* uses a highly refined version of NetBIOS, and both provide fast throughput. *LANtastic* may gain some advantage at the transport layer because its driver is optimized for the hardware, while Novell offers compatibility with more LAN adapters through its ODI-conforming software layers.

LANtastic has a significantly better caching system than *NetWare Lite*. *NetWare Lite* includes read and write caching, but we found significant improvements in disk reads when we used DOS 5.0's SMARTDRV.SYS disk cache program with *NetWare Lite*.

The **Workstation Throughput Evaluation** test reports the throughput recorded on a single PC during the performance of a standardized task on the network, and is run in conjunction with the Hard Disk Access Load test. The test program performs sequential and random reads and writes to the hard disk using a 1MB file. The record size systematically rotates among 16K, 4K, and 512 bytes. The throughput is reported in kilobits per second.

The **Hard Disk Access Load** test reads random blocks of data in 1K increments from a 10K file on the server. The results of this test are reported in requests per second for all the PCs running the load test.

Taller bars represent better performance.



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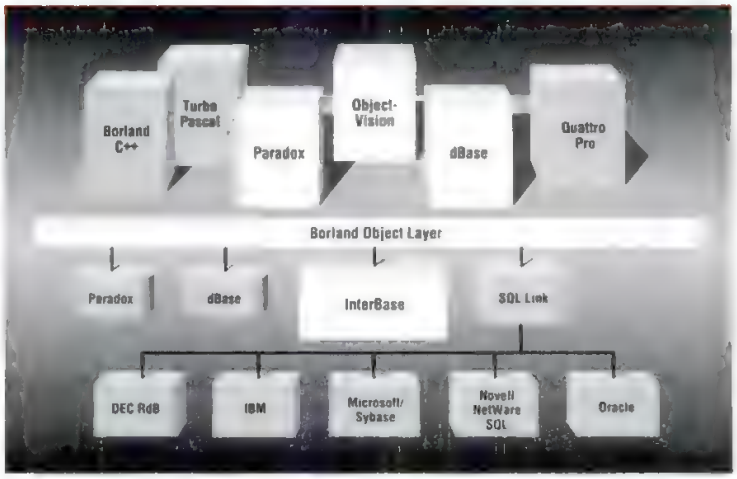

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*1991 J.D. Power and Associates' Computer End User Satisfaction Study: Phase I: Office-Based Small to Medium-sized Businesses℠ Response from Business End Users at 1,784 business sites. Small to medium-sized businesses were based on office sites with between 1 and 499 employees. 1991 J.D. Power and Associates' Computer End User Satisfaction Study: Phase III: Office-Based Large Businesses℠ Responses from Business End Users at 1,094 business sites. Large businesses were based on office sites with 500 or more employees. J.D. Power and Associates is a service mark of J.D. Power and Associates. †Dealer prices may vary. Upgrade pricing good in U.S. and Canada only. Borland is a registered trademark of Borland International, Inc.

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CIRCLE 287 ON READER SERVICE CARD

Microsoft Works

CONTINUED FROM PAGE 35

large nonresizable icon.

You can use the word processor's drawing component—*Microsoft Draw*—in order to create pictures and diagrams for your documents and to import clip art in *Windows*' Metafile format.

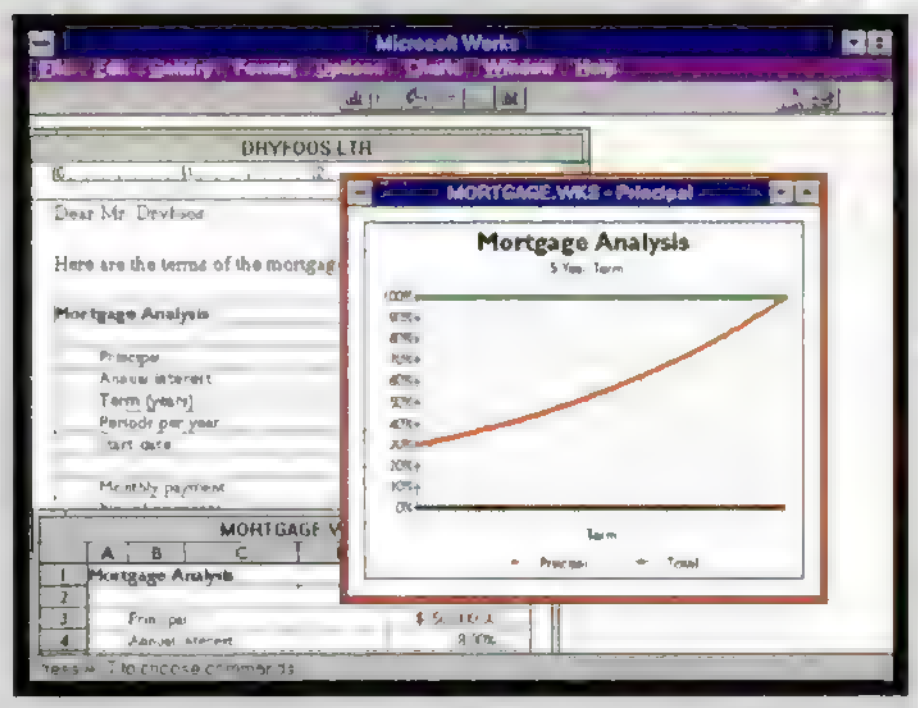
Mail-merge is important in both home and small office environments, and *Works* has plenty to offer in this area. It has two settings for data-driven printing: one for form letters (which prints one record per page), and one for labels (which prints multiple records per page, one or more records across).

You can place database fields anywhere in your document and format them as you like. You then open up the database file, filter the records you want, go back to the word processor, and print.

This roundabout process won't be completely transparent to a novice, but Microsoft has not forgotten those who need guidance. Wizards (which are macro front ends that do particular tasks across *Works* modules) help you to build an address book file (in three different formats), and to create and print mailing labels and form letters from it, step by step.

The Wizards are very visual, with lots of tutorial information, and do a good job of leading you through the process. Unfortunately, their simplicity comes at the cost of flexibility. The label and form letter Wizards work only with databases whose names are strictly defined by the address book Wizard. Getting these Wizards to work with an existing database can be difficult. Another gripe: The label-printing routine isn't intelligent enough to close up lines on empty fields.

Works for Windows' database manager, a simple flat-file design with few frills, is less impressive. It is easy to use, offering both Form and List (that is, table) views, which are quickly and conveniently selectable from the icon bar. An additional Query view lets you filter records quickly using a fill-in-the-form approach, and you can easily sort the data on any field through a menu entry.



In addition to more traditional ways of integrating *Windows* data, all of the *Works* components are OLE (Object Linking and Embedding) aware.

There are no lookup tables, indexes, substring functions, or other advanced features. And if you want to do more than create a simple list or query on a single field, you must type codes into the print columns or fields; there's no system of dialog boxes or list boxes to help you remember the operators and functions.

Also, it's still RAM-based and limited to 32,000 records per database. Though it's adequate for address books and other simple lists, if data handling is important to your work, it's simply no substitute for a more powerful program like Symantec's *Q&A*.

The last ingredient in the recipe is a Spartan spreadsheet that is reasonably complete in the essentials (although there is no way to convert formulas to values, for instance). Its working methods are standard, and its 57 functions and 14 operators are enhanced with a few conveniences such as an auto-sum button on the icon bar.

Its excellent charting function uses a visual chart gallery: You simply mark a block of numbers and then pick from a good selection of basic charts (including high-low for stock quotes) to graph it. The chart formatting options are minimal, and the menus can be a bit unwieldy when it comes to finding and setting options, but they do the job.

The only real disappointment comes when you want to publish your spreadsheet. You can paste the charts as graphics into the drawing component to touch them up further, but you can use only one font size per worksheet. And you can't print spreadsheets alongside embedded charts.

To be fair, though, the program is not designed to be used that way. You're expected to paste all such elements into the word processor—the hub of *Works for Windows*' integration capabilities—where you have more flexibility in typography and layout.

You can insert charts, tables, and graphics—not just spreadsheets—into your documents. Microsoft's use of its Object Linking and Embedding (OLE) specification between *Works* applications allows you to edit inserted data and graphics simply by double-clicking on them.

You can even embed objects from other applications that support OLE, though our experience shows that it would be foolish to rely on this unfinished technology, which only works well with known pairs of applications. Our attempt to embed a chart from Micrografx' *Charisma*, for instance, resulted in a grotesque failure.

Fortunately, there are other, more traditional ways of integrating your data. Cutting and pasting spreadsheet data or database tables through the Clipboard is a simple, transparent process, with none of the gotchas that can mar the process. Creating DDE paste links from the spreadsheet or database (or any *Windows* application that supports them) is equally straightforward. And the *Works for Windows* program imports and exports all the important standard file formats, from .DBF and .WK1 through a variety of ASCII formats.

Be aware of the program's significant limitations. Since the word processor is strictly line-based, you can't place text side by side with imported objects, nor can you wrap text around them as you can with a desktop publishing program such as Microsoft's *Publisher*. This sharply restricts the advantage you get from *Works*' graphical abilities.

Moreover, since the word processor has no drawing tools of its own, all graphics elements, even simple rules, must be created within the draw component and inserted into your documents. To resize or crop a rule, for example, you have to jump back and forth between word processor and draw component, or insert numerical scaling factors.

Microsoft Works for Windows won't astonish you with new and exciting features, but it does make good use of the visual qualities of *Windows*. It's a solid program that will do the job well for a wide range of users with simple requirements. If you can live within its deliberate limitations, it's a good deal for the money. ■

List Price: *Microsoft Works for Windows*, $199; upgrade from *Microsoft Works* or any other DOS-based integrated package, $79. **Requires:** 1MB RAM, DOS 3.1 or later, *Microsoft Windows* 3.0. Microsoft Corp., 1 Microsoft Way, Redmond, WA 98052-6399; 800-426-9400, 206-802-8080.

CIRCLE 444 ON READER SERVICE CARD

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June 6, 1991

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Quattro Pro: The standard of excellence.

InfoWorld reviews confirm what more than one million PC users already know: Quattro Pro is the best DOS spreadsheet that money can buy. Better than *any* Lotus spreadsheet including their recently released version 2.3.

Just check out the *InfoWorld* review results below. Quattro Pro wins in comparison to Lotus 1-2-3® hands down in *InfoWorld* and with more than 1,000,000 enthusiastic users.

Number of...	Quattro Pro 3.0[1]	Lotus 1-2-3 v. 2.3[2]	Lotus 1-2-3 v. 3.1[3]
"Excellent"	7	2	3
"Very Good"	8	4	5
"Good"	0	5	4
"Satisfactory"	2	5	3
"Poor"	0	1	1
Overall score	**8.4**	**6.3**	**6.5**

1 Source: *InfoWorld*, April 29, 1991. 2 Source: *InfoWorld*, June 10, 1991
3 Source: *InfoWorld*, January 28, 1991

REPORT CARD — INFO WORLD

SPREADSHEET SOFTWARE
Quattro Pro
VERSION 3.0

Criterion	(Weighting)	Score
Performance		
Formulas/analysis	(100)	Very Good
Compatibility	(50)	Very Good
Speed	(75)	Very Good
Database	(75)	Excellent
Graphics	(75)	Excellent
Output	(50)	Excellent
Macros	(50)	Very Good
Consolidation/linking	(50)	Excellent
Capacity	(50)	Very Good
Network	(50)	Satisfactory
Documentation	(50)	Excellent
Ease of learning	(50)	Excellent
Ease of use	(75)	Very Good
Error handling	(50)	Very Good
Support		
Support policies	(25)	Very Good
Technical support	(25)	Satisfactory
Value	(100)	Excellent
Final score		8.4

We don't blame Lotus for trying to underplay ratings such as these, but clearly Quattro Pro is more powerful. It has better graphics, better capacity, better macros, better consolidation and linking, and much more!

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PC MAGAZINE — EDITORS' CHOICE — OCTOBER 1989

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CIRCLE 285 ON READER SERVICE CARD

Microsoft Publisher

HANDS ON
by Alfred Poor

There's never been an easy road to quick desktop publishing. Most desktop publishing software asks that you devote your life to learning about kerned letter pairs and hyphenation dictionaries. Word processors, on the other hand, can handle graphics, many fonts, and multiple column formats, but only under duress.

Striding boldly into the middle ground comes *Microsoft Publisher*. The $199 *Publisher* gives you an appropriate tool for document design without demanding that you become a graphic arts professional in the process. *Publisher* is ideal for the occasional desktop publishing project where ease of use and speed to finish are more important than sophisticated typographical refinements.

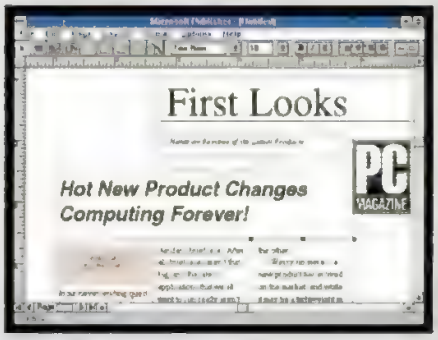
The program uses the *Windows* interface to good advantage, with icons and on-screen clues for those who prefer to work with a mouse, as well as lots of keyboard shortcuts for the touch-typists among us.

Publisher is designed around the concept of frames; some hold text, others hold graphics. You create and fill frames on your page, drag them around, resize them, copy them, or get rid of them if you change your mind. The package comes with more than 100 color and black and white pieces of clip art, and you can import from 13 image formats and 8 text formats.

Other features that make page layout easy include "snap-to" grids, the ability to stack frames on top of each other and control which layer is on top, and on-screen column guidelines that allow precise formatting and consistent design. The program will automatically flow text from one frame to another if you wish, or you can do it manually with a simple procedure. And if you're familiar with almost any of Microsoft's other *Windows* applications, you'll already know about many of the formatting conventions for bolding, italics, paragraph alignment, and other options.

Publisher comes with a spell-checker, a hyphenation utility, and a coupon for Bitstream's *FaceLift* program, which can make your documents look better both on-screen and on paper.

Publisher also packs some novel extras that you're not likely to find in any other program, whether it is a high-end desktop publishing package or a sophisticated word processor. Word Art lets you create amazingly formatted text along curves or angles using a variety of special effects. For example, you can arch or stretch text or create text that flows in a circle.



You may not want to produce a magazine with it, but *Microsoft Publisher* is an excellent page layout tool that is easy to use and has lots of clever surprises.

Like *Microsoft Works for Windows*, reviewed on page 35, *Publisher* also employs Page Wizards, which are preprogrammed routines that can interactively step you through the creation of newsletters, ads, calendars, or even paper airplanes. Page Wizards operate by presenting you with a series of design questions. As you specify the answer, the Wizard provides the optimal template and offers a preview of what the document might look like.

Printout support goes far beyond almost anything else you'll find. There's a format for creating greeting cards—text and images are automatically rotated so that when you fold a single printed sheet, you get a four-sided card perfectly aligned. Another format prints two "pages" to a single sheet of paper. If your document has even multiples of four pages, these sheets will be arranged so that you can fold them in the middle to create a booklet, no cutting and pasting required.

Publisher requires more effort than a word processor to format a document, and a high-end destop publishing program does have some typographical advantages. But if you want to create attractively formatted documents without spending weeks to master a program, give *Microsoft Publisher* a spin. This program is so easy to use, yet so varied and rich in features, that it is just plain fun. ■

List Price: *Microsoft Publisher*, $199. **Requires:** 1MB RAM (2MB recommended), DOS 3.1 or later, *Microsoft Windows* 3.0 or later. Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; 800-426-9400, 206-802-8080.

CIRCLE 700 ON READER SERVICE CARD

Microsoft Money

HANDS ON
by Bill Howard

Take Intuit's personal finance program *Quicken*, move it to *Microsoft Windows*, and make it even more idiot-proof, and you have not one but two products—*Microsoft Money* and *Quicken Windows*.

Money ($69.95) beat *Quicken Windows* out the door by about a month. It's a product absolutely brimming with essential goodness. But is it the best personal finance product? The question remains. Based on the shipping versions of *Money* and the equally new *Quicken* 5 (for DOS), and what we've seen of the almost-finished *Windows* version of *Quicken*, here's our first take on who's on top: *Money* is the product to recommend to friends who want a personal finance program they can't screw up, while *Quicken Windows* and *Quicken* 5 are the products of choice if you want a richer features set and unsurpassed ease of use—that is, unsurpassed except by *Money*.

Microsoft Money unabashedly borrows *Quicken*'s best features and key combinations, from the paper-check-on-screen check-writing metaphor to the use of the back cover of the manual for a command summary (the manual is 164 pages, a third the length of *Quicken*'s). If Apple owned *Quicken* instead of the good-natured Intuit, wags might argue, Microsoft would quite possibly have another sticky lawsuit on its hands. But *Money* follows the *Quicken* outline more than it follows the details.

Microsoft Money lacks features such as *Quicken*'s electronic check writing, investment tracking and asset management, super smart tax-category links, small-business features, and memorized reports. Some omissions are a matter of degree: *Money* limits you to two categories and two classes per item (a class being a kind of category), while *Quicken* allows as many as you can fit in 31 characters.

Installation is a snap. All you need is *Windows*, 1.7MB of disk space, and a printer for your checks. Once you're up and running, you can have several views of your work screen in different windows: the Account Book (a checkbook register), Checks & Forms (electronic paper checks), and Future Transactions (a list of transactions you can set up now and ex-

CONTINUES ON PAGE 42

From C to Shining C++ Borland Covers the Territory

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CIRCLE 295 ON READER SERVICE CARD

Microsoft Money

CONTINUED FROM PAGE 40

ecute later on). You can also have smaller windows for payee lists, categories, classes, and so on. A well-executed toolbar provides single-click access to things you'll do often. It looks like this:

The tools here are, from left to right: expanded and single-line check register, find transaction, calculator, split transaction, future transaction, and balance checkbook.

Money automatically remembers everything you type in about every transaction: payee, address, amount, and memo. If you begin to enter the same transaction later, *Money* sees that the first few characters are the same and proposes that you reuse the existing transaction information. This feature, called SmartFill, is far more refined than *Quicken*'s Ctrl-M memorize, Ctrl-T recall-transaction syntax. You can also create shortcuts or aliases: Type *Braces* and *Money* fills in a check to your kid's orthodontist.

Money has the usual paper checks: dot matrix and laser printer, voucher, and plain. Tree-huggers will be annoyed to learn that *Money* laser checks have a throwaway strip at the bottom to make three checks add up to exactly 11 inches deep. But you'll waste fewer checks to alignment glitches, so it's a wash.

Report generation is adequate, but on-screen reporting is flawed because an immovable menu stripped down the right side keeps you from seeing complete lines in reports without scrolling. While there are business reports and business checks in *Money*, it's better suited to personal use and the very smallest, simplest of businesses, where the owner either trusts or *is* the bookkeeper. The Reconcile module can find common mistakes such as transpositions automatically: If your checkbook is off by 9 cents, it will look for something like a $31.65 entry that should be $31.56.

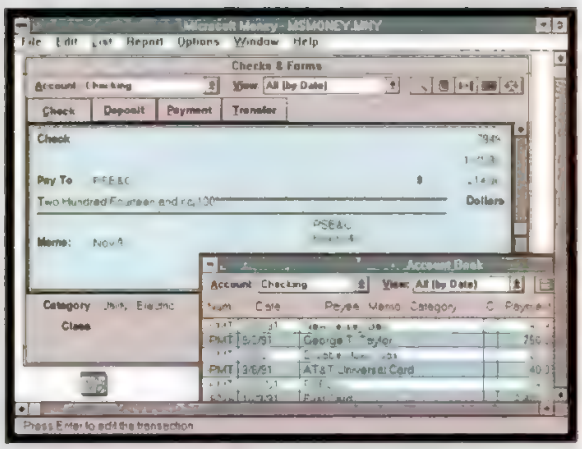
Other items that need work: Screen font choices are 8-and-10 point Helvetica (both too small). There's a bug that renders your mouse unusable with drop-down menus if you're running under *Norton Desktop for Windows*. (Temporary fix: Call NDW's Configure-Preferences menu, then turn off these Control Menu options: Launch List, Launch Manager, and Task List.)

Money ignores *Windows* conventions such as using the mouse to fine-tune column widths (accomplished by grabbing the column divider and dragging) or using F8 to mark a block. Phone support is suspect since it's Microsoft phone support, but *Money* does have its own number and a guaranteed pledge to match *Quicken*'s superior support levels.

Microsoft's first job at *Quicken* is a bull's-eye. *Money*, Version 1.0, is a great first effort that's easy to use, makes it easy to get everything right, and has adequate features that are best suited for home users and very small businesses. What was left out won't matter to most users, and what's broken can be fixed easily. If you don't mind these limitations, you will love *Money*. ■

List Price: *Microsoft Money*, $69.95 (less $5 rebate check valid through Dec. 31, 1991). **Requires:** 1.7MB disk space, DOS 3.1, *Microsoft Windows* 3.0. Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; 800-426-9400, 206-802-8080.

CIRCLE 703 ON READER SERVICE CARD



Microsoft Money, $69.95, lets you have several views of your personal finances on-screen simultaneously; here, a check-writing window and a check register.

QUICKEN VS. MICROSOFT MONEY

The fifth version of Intuit's DOS product *Quicken* and Intuit's first *Windows* version, both $69.95, and both $24.95 for an upgrade for current users, show continued improvements and ingenuity. *PC Magazine* will have First Looks reviews of both products as soon as *Quicken for Windows* ships from Intuit (800-624-8742, 415-322-2800). In the meantime, here's how the *Quicken*-versus-*Microsoft Money* battle shapes up from the Intuit side.

The new DOS version is easy to explain. It's *Quicken* 4 plus mouse support (Alt-key menus can be used as an alternative), PostScript printing, wallet-size laser printer checks that won't get crinkled the way voucher checks do, reports that can be compressed or expanded to show levels of detail, even better date keys (for instance, just type M or H or go to the first or last day of the month), the ability to toggle between a report and the check register, and percentage allocations (each roommate pays one-third of the heating bill, however much the total is).

There's also a loan amortizer that automatically figures out how much of your mortgage payments goes to interest and principal, but it stumbles if your bank also withholds money for taxes or insurance.

Quicken for Windows has most of the *Quicken* 5 features, except the loan amortizer (no loss). Like with *Money*, *Quicken* lets you have several windows and accounts active simultaneously. There's an icon bar, although it's not as well thought out or as legible as *Money*'s. Auto Recall, *Quicken*'s automated data-entry tool, doesn't work as well either, and occasionally it misses matches it should find.

On depth of features, *Quicken* still holds the lead over *Money*: two-level password security, lockable transactions, a payroll module, Check Free electronic bill-paying, can't-miss printer check alignment, and highly customizable reports.

For small-business users, *Quicken* remains the tool of choice, and for individual users, the issue boils down to this: Do you want a bit more ease of use or a lot more features? If it's features you want, either *Quicken* will serve your purpose.—*BH*

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† Contact QMS for availability of network options.

*Patent pending

NEC ProSpeed 486SX/C: 486 Power, 256 Color Display and Luggable

HANDS ON
by Christopher Barr

NEC Technologies follows Dolch's and Toshiba's lead as the latest manufacturer to offer a luggable 486SX with a color screen. The ProSpeed 486SX/C stands separate from the others because it supports 256 colors, not just 16. Its active-matrix thin film transistor (TFT) screen is manufactured by NEC. Dolch uses a Hitachi-made screen; Toshiba uses one developed jointly by Toshiba and IBM.

Measuring 4.2 by 14.8 by 15.6 inches (HWD), the ProSpeed's case is about identical to the Toshiba T3200SXC. At 16.8 pounds, this AC-only clamshell could only be used as a laptop by those with Schwarzenegger-size thighs.

The active-matrix screen and the 486SX processor require power, so the first thing you notice about the ProSpeed 486SX/C (before the opening screen comes up) is the racket caused by the fan. To provide adequate power, NEC installed a power supply that occupies the entire back upper deck. The noise isn't deafening, but it's quite noticeable.

The most impressive feature of the ProSpeed 486SX/C is ultimately a bit disappointing. The screen is too dark in average office light; it looks best in low lighting. The screen must be displayed at a perfect 90 degree angle for the best viewing of the colors. There is only one sliding control to adjust the brightness and contrast, and even at its brightest setting the screen is still too dark.

Besides the parallel and serial ports, the ProSpeed 486SX/C has a PS/2 mouse port and an external 1.2MB floppy disk drive port. It can simultaneously drive its own display and an external VGA at 640-by-480 resolution with 256 colors. The Paradise chip set–driven external VGA can also drive monitors at resolutions up to 1,024 by 768, but not simultaneously with the built-in display.

The NEC case houses nooks and crannies for expansion options. There's one full-sized EISA 32-bit slot accessible by removing the back plate. An opening to the right of the external ports accepts a proprietary NEC expansion bus interface board that connects to an optional NEC Expansion Station. This adds three full-size 16-bit slots, one short 8-bit slot, one internal and one external half-height 5¼-inch drive bay, parallel and serial ports, and an external floppy disk drive connector.

There's room for an optional internal data modem or fax/modem. The ProSpeed has an IDE hard disk controller and a 120MB Conner hard disk that's easy to reach by removing the cover. It also provides access to the 487 socket and internal modem slots.

The unit ships with 2MB of RAM and has six free SIMM sockets that are easily accessible from the top of the case. It can address up to 20MB of RAM through a combination of 1MB and 4MB SIMM.

Since this is not a full-fledged 486DX, the ProSpeed 486SX/C has a zero-insertion-force (ZIF) PGA socket that uses an easy-in/easy-out lever to release and seat a 487SX coprocessor.

It turned in mediocre benchmark test scores. It was slightly slower than the initial batch of 486SX desktops we reviewed ("486/25: Newly Affordable Power," June 11, 1991).

Color portables are popular with presenters, scientists, engineers, and programmers working with graphics. For now you'll pay a premium for color, power and portability. The ProSpeed represents the top of the line rig for these users. ■

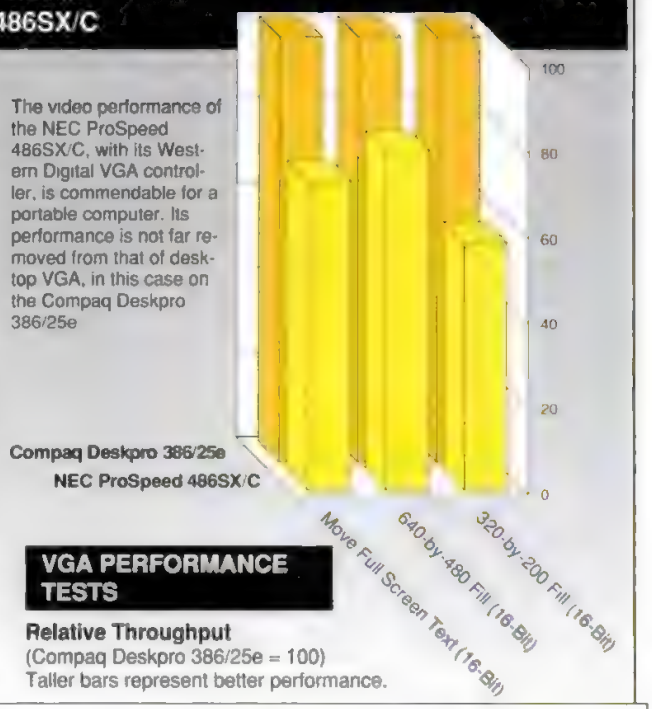
PERFORMANCE TESTS: NEC PROSPEED 486SX/C

The **Move Full Screen Text (16-Bit)** test writes text to the graphics adapter's screen memory via 16-bit moves. A full-screen move best represents adapter throughput because there is almost no software overhead involved. We run the test for 10 seconds and report the results in kilocharacters per second (1 kilocharacter = 1,000 characters).

The **640-by-480 Fill (16-Bit)** test fills the video memory with color information via VGA write mode 0 (a common write mode used by many software programs). This test measures the graphics adapter's throughput in graphics mode.

The **320-by-200 Fill (16-Bit)** test fills the video memory with color information utilizing the 256-color VGA mode at 320-by-200 resolution. This test predicts 256-color Super VGA performance. We run both Fill tests reported here for 10 seconds and report the result in megapixels per second (1 megapixel = 1,000,000 pixels).

The video performance of the NEC ProSpeed 486SX/C, with its Western Digital VGA controller, is commendable for a portable computer. Its performance is not far removed from that of desktop VGA, in this case on the Compaq Deskpro 386/25e.



VGA PERFORMANCE TESTS

Relative Throughput
(Compaq Deskpro 386/25e = 100)
Taller bars represent better performance.

Higher scores represent better performance.	Move Full Screen Text (16-Bit) (kilocharacters per second)	640-by-480 Fill (16-Bit) (megapixels per second)	320-by-200 Fill (16-Bit) (megapixels per second)
Compaq Deskpro 386/25e	1,346.17	22.28	3.83
NEC ProSpeed 486SX/C	977.82	17.79	2.23

FACT FILE

ProSpeed 486SX/C
NEC Technologies Inc., Massachusetts Ave., Boxborough, MA 01719; 508-264-8000
List Price: $8,999, with 2MB RAM, 120MB hard disk, DOS 5.0, *Microsoft Windows* 3.0. Expansion Station, $1,299; data modem, $335; fax/modem, $585; external floppy disk drive, $290.
In Short: The first luggable to use a 256-color active-matrix TFT screen. The case is big, the power supply fans are too noisy, and the screen is too dark.

CIRCLE 701 ON READER SERVICE CARD

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CIRCLE 164 ON READER SERVICE CARD

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The following are trademarks or registered trademarks of their respective companies: QMS, ColorScript and the QMS logo of QMS, Inc.; Adobe and PostScript of Adobe Systems, Inc.; IBM of International Business Corp., AppleTalk and Macintosh of Apple Computer, Inc
QMS ColorScript 100 Models 10 and 30*i* shown

WindowBase: SQL Made Pretty, but Slow

HANDS ON
by Richard Hale Shaw

WindowBase, from Software Products International, offers a single-user, application-building data-management environment that's SQL-based but doesn't require you to learn the SQL language. It lets you build SQL queries through an attractive series of dialogs. But without more data gateways, import/export capabilities, and some fine tuning on the interface, it falls short of the mark.

The $495 package is targeted at those who want to use SQL interactively without programming. You can build forms and reports that use SQL to specify the tables and objects to be displayed and to filter out unwanted rows. For example, when you begin building a query, a dialog appears with each clause of a SQL query (Select/From, Define Columns, and Where), displayed in push buttons.

Press the Select/From push button and you can specify the tables and columns retrieved by the query, by selecting table names and columns from list boxes. The Where button invokes a dialog for placing conditions on column selections by clicking on operators and relations. You can also add subqueries to the WHERE clause (this invokes the same dialogs for the subquery being defined). In addition, there are buttons for the Group By, Having, and Order By clauses. You can create a view from the query or save it for reuse in a text file.

WindowBase is organized into ten activities that enable you to create, design, and use queries, tables, forms, reports or menus. Developers use the Design activities; users use the Access activities. Each activity takes over the *WindowBase* interface and establishes a new layer of menus.

The activity process can be disconcerting. A less modal approach, perhaps one that used an MDI window with a child window or icon for each different activity, would be preferable. As it stands now, the structure is inflexible, constricting, and confusing.

Creating forms with *WindowBase* is even more interactive than creating queries: You select objects from a palette and place them where you want them to appear in the form. (You can also let *WindowBase* create default objects based on the query you've defined.) Form objects include bitmaps, scrollbars, check boxes, repeated sections, and cells. Repeated sections—a very intriguing idea—are like list boxes, except they correspond to multiple rows from the same table. Cells are like edit boxes; they let you look at and enter data. *WindowBase* also provides a number of predefined record-based commands, such as Next, Previous, Add, Delete, and Search. You can link these commands to buttons in the form to build applicationlike functionality into the form interface, without programming.

A *WindowBase* report operates the same way as a form, but the report is divided up into sections: introduction, page and group headers, the report body, various totals, and a footer. You can also use SQL Joins to include information from multiple tables and insert .PCX bitmapped graphics into a report.

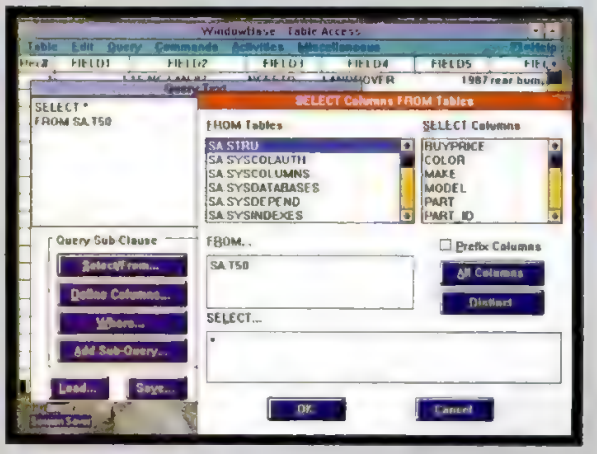
One powerful but disturbing feature of *WindowBase* is dependent queries. These are queries whose results depend on other queries. You can use them to build what appears to be a single table from disparate ones—the equivalent of a SQL Join. *WindowBase* relies on dependent queries to let you build a form from multiple tables and update them. However, dependent queries will let you update and modify the related tables—something that SQL does not let you do. While the documentation acknowledges that dependent queries are not supported by standard SQL, this operation offers opportunities for violations of relational integrity.

WindowBase offers support for *Windows*' Dynamic Data Exchange (DDE), and supports DDE conversations as both a client and a server. You can use forms in either capacity, but reports can only be DDE clients. As a client, *WindowBase* lets you create Cold Links for on-the-spot requests for data, Hot Links for updates when the server's data changes, and Paste Links to call the server to display and edit the data. With Paste Link, the Server application "owns" the data and is specifically invoked to provide it.

Unfortunately, *WindowBase*'s performance is not up to speed. Tested against *SuperBase4*, Version 1.3 (no speed demon itself), we found *WindowBase* about 40 percent slower to update a table, more than twice as slow when searching for a set of records, and more than ten times slower to import data. Running the tests on a 386-based machine running at 33 MHz, we found *WindowBase*'s overall performance generally sluggish.

Given the observable inconsistencies in its interface, the lack of a runtime facility (until 1992), the lack of import/export facilities for *dBASE*, *Paradox*, or .WK*x* files, and the lack of network support, this version of *WindowBase* has a long way to go. To make matters worse, the documentation and promotional materials that are included refer to features such as the runtime facility, toolkit, and gateways that do not yet exist.

WindowBase is certainly a potentially good product. Its facilities for creating forms and reports while making SQL palatable make it extremely attractive. But much like many first-generation products, it has too many rough edges at the current time. WindowBase needs polish before it can receive our endorsement. ■



WindowBase's Query Building feature lets you interactively build a SQL statement from a series of dialog boxes and save it to disk.

FACT FILE

***WindowBase*, Version 1.0**
Software Products International
9920 Pacific Heights Blvd., San Diego, CA 92121; 800-937-4774.
List Price: $495
Requires: 2MB RAM, DOS 3.1 or later, *Microsoft Windows* 3.0 or later. Supports ANSI-standard SQL.
In Short: An easy-to-use data manager with powerful form-building and report-generating facilities. Performance, gateway, and interface problems mar this fledgling version.

CIRCLE 447 ON READER SERVICE CARD

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CIRCLE 247 ON READER SERVICE CARD

WordStar for Windows: It's More Like Legacy Than WordStar for DOS

HANDS ON
by Edward Mendelson

The name on the box is *WordStar for Windows*, but don't expect to find a GUI version of *WordStar* for DOS inside. What you get from this $495 package is an improved and streamlined version of NBI's *Legacy* 1.1 (also marketed as *WordStar Legacy*), a program noted for its advanced layout control and an awkward interface. The only connection between the new *WordStar for Windows* and classic *WordStar* is an option that lets you use *WordStar* keystrokes when editing.

Even if you don't care about *WordStar* keystrokes, *WordStar for Windows* is a program rich in features usually available only in desktop publishing packages or in graphics-oriented word processors like *Ami Pro*. You get easy access to special effects like large drop capitals at the beginning of a paragraph, precise control over letterspacing and kern pairs, and highly customized borders around the page or around graphics, tables, and text frames. DDE support is more flexible than in any other *Windows* word processor.

For fancy pages, you can use the provided document templates, or you can draw simple graphics and import and scale widely supported formats like TIFF and .PCX (sometimes with unreliable results). You can insert text in frames that "float" with surrounding text, and you can create linked frames on different pages so that text flows automatically from one frame to the next. And for better control over the text itself, a thesaurus offers synonyms and antonyms. *Correct Grammar for Windows* comes in the package.

Like *Legacy*, *WordStar for Windows* lets you work either in a page layout mode where you can edit footnotes and headers in their true position on the page, or in an unformatted draft mode. Draft mode is fast and ugly. It uses the *Windows* system font, and optionally displays formatting codes. Undo works only in page layout mode; if you backspace over a footnote code in draft mode, the whole note is gone forever.

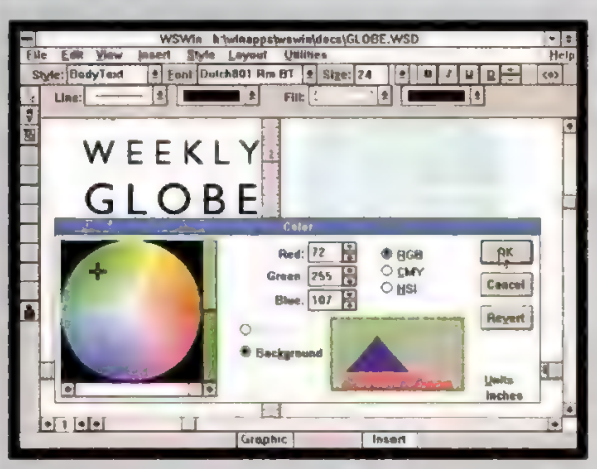
One of *Legacy*'s most confusing features is its division between an editing mode, where you create text and graphics, and a frame mode, where you work with the frames that contain them. *WordStar for Windows* simplifies this division, but not enough. Users may be baffled to find that they can't open the Layout Document menu until they click on the tool that looks like a mouse pointer on the program's icon bar.

It's easy to do basic editing, and the optional *WordStar* keystrokes make navigation and deleting almost intuitive. But *WordStar* loyalists may be dismayed to find that some familiar keystrokes don't work. You can't use Ctrl-KB and Ctrl-KK to define a block; you define only by clicking and dragging or holding down the Shift key while you move the cursor. You also don't get the DOS version's adjustable help levels.

When you attempt advanced editing, you're likely to encounter some of the program's design weaknesses. The search menu won't automatically move out of the way if it happens to display in front of the string it finds in the text; until you get used to this strange behavior, you'll suspect that the string wasn't found. Similarly, if a word flagged by the spell-checker happens to display on a part of the screen that's hidden by the spell-check menu, the menu won't get out of the way to let you see it—even if you choose the option to display flagged words in context. You have to move the menu by dragging it with the mouse. Don't try to save time by using the spell-checker in draft mode; you can't.

Unless you modify and save the default template (not an intuitive task), you'll get an error message asking if you want to choose a printer every time you create a file. Importing another word processor's files from the import menu produces different results from the File Open menu, but the difference is mentioned only in a README file.

Performance is agreeably fast when entering or scrolling through text, but opening and printing files is painfully slow.



The color wheel in *WordStar for Windows* lets you choose colors more easily than in any other word processor. Note also the rulers that can be located at any point on-screen.

FACT FILE

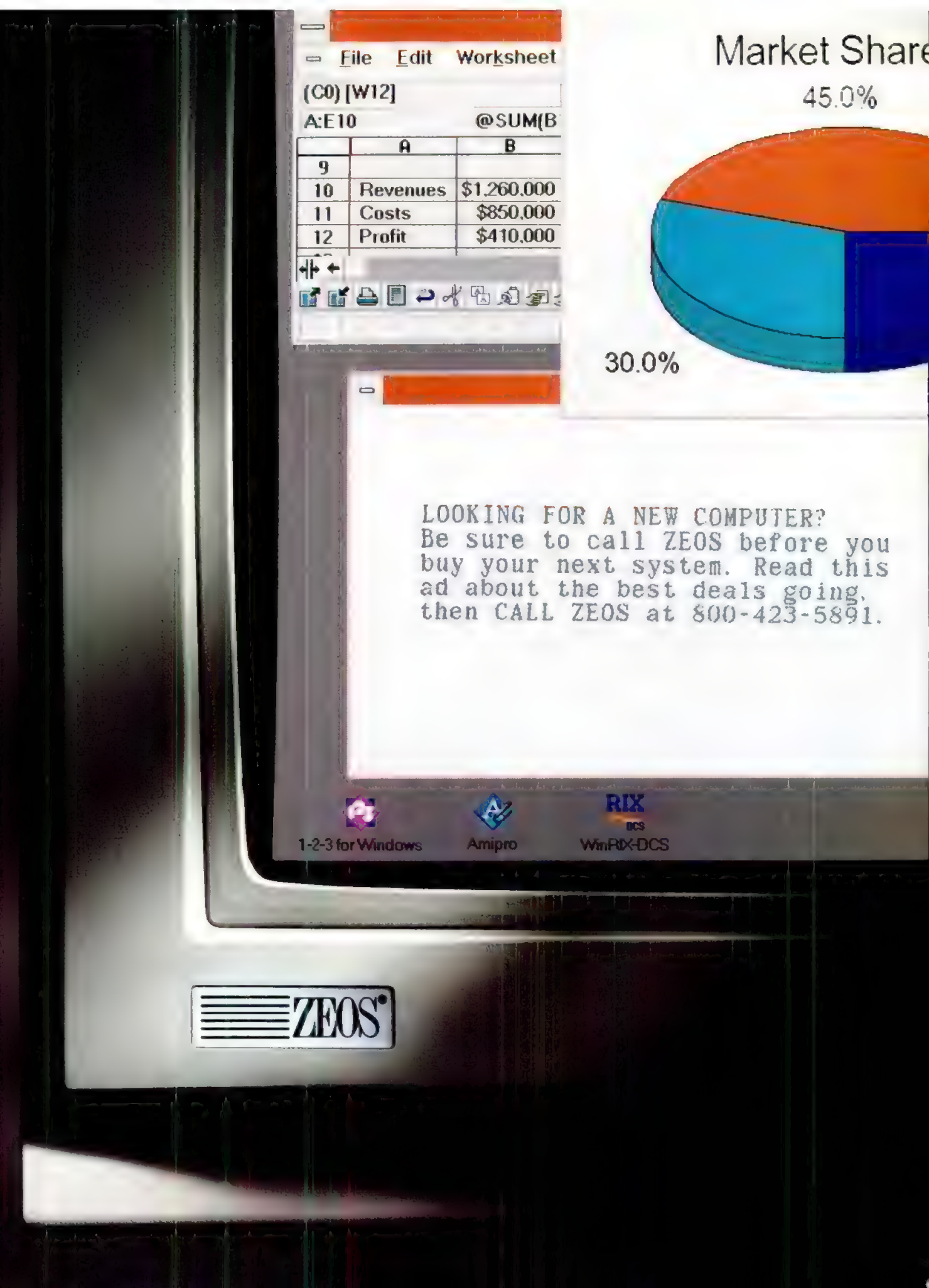
WordStar for Windows
WordStar International Inc., 201 Alameda del Prado, Novato, CA 94949; 415-382-8000.
List Price: $495; upgrade from *WordStar Legacy*, $49.
Requires: 2MB RAM, 20MB hard disk space, DOS 3.1 or later, *Windows* 3.0, mouse.
In Short: A *Windows* word processor with optional *WordStar* keystrokes and advanced layout options, but slower and more awkward than its competition.

CIRCLE 710 ON READER SERVICE CARD

On my system, the program uses more than twice the system resources of *Ami Pro*. Unlike other *Windows* word processors, it can only open one file at a time unless you open two copies of the program—and its high memory demands may make that almost impossible.

The README file warns that endnotes aren't visible on the page layout screen, but doesn't warn you that you can't even insert endnotes until you switch to draft mode. Once, when I reopened a file I had saved in the previous session, all font information had disappeared from the stylesheet and had to be restored by hand. A built-in tutorial lets you practice on the standard editing screen, but makes you use the mouse instead of the keyboard shortcuts. The tutorial can easily get confused and give instructions that don't match the screen, and it once generated a fatal error that dropped me back to *Windows*.

If you need *WordStar* keystrokes in a *Windows* word processor, *WordStar for Windows* is the program to choose. But if you want *WordStar for Windows*' advanced *Legacy*-style control over layout, you may decide to wait for *Legacy* 2.0, rumored for release later this year. Meanwhile, if you want a *Windows* word processor with features like macros and multiple documents, which you don't get in *WordStar for Windows*, *Ami Pro* is available right now, and *Microsoft Word for Windows* 2.0 and *WordPerfect for Windows* aren't far behind. ■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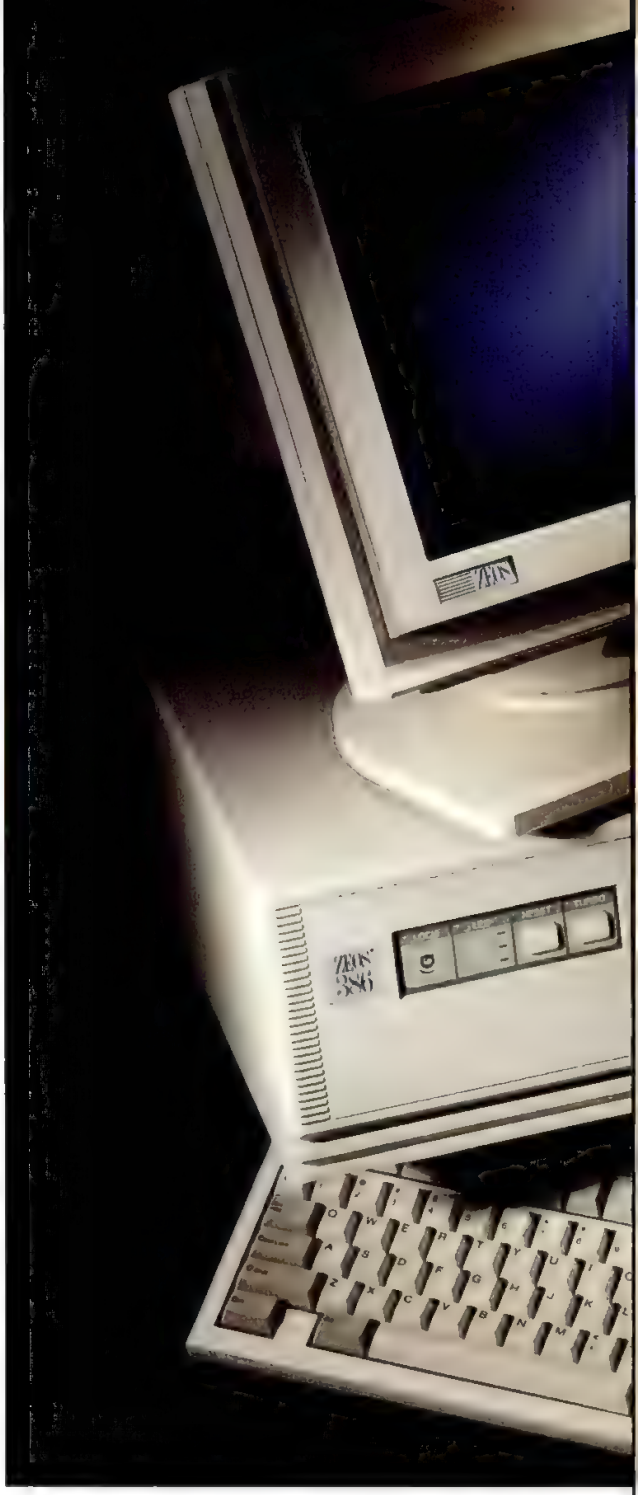

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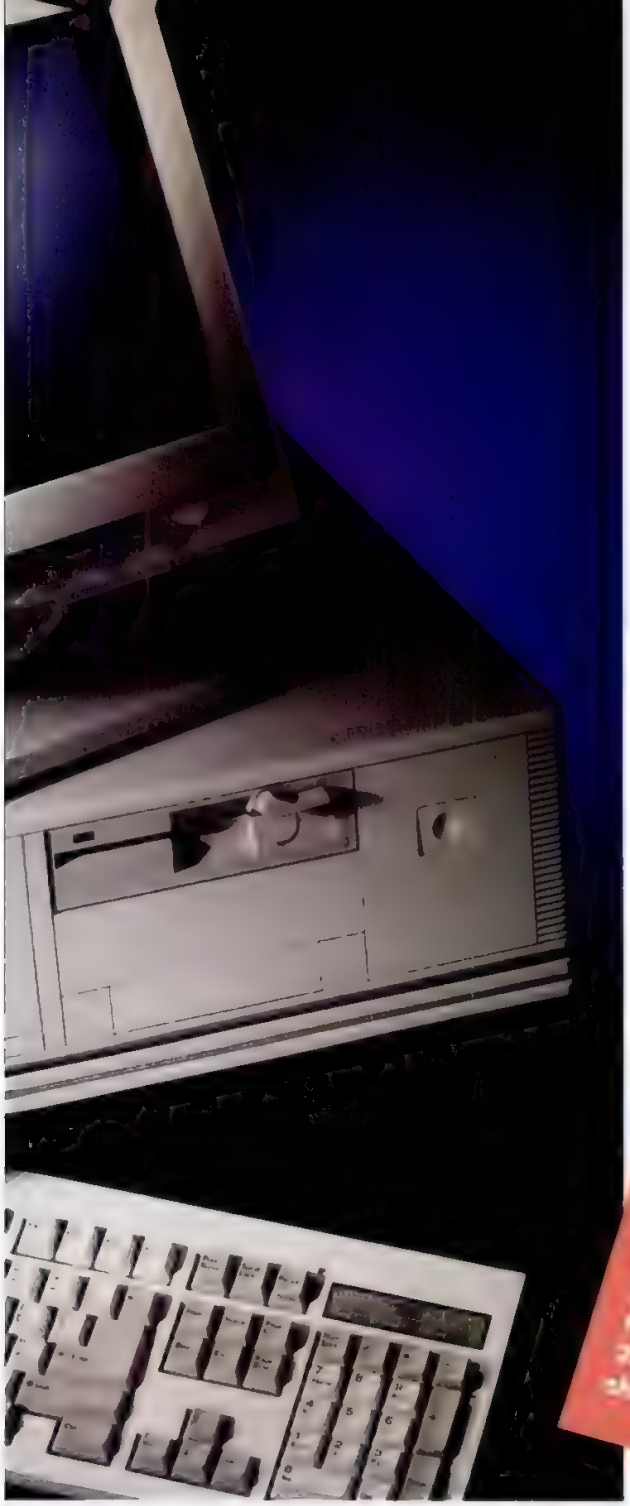
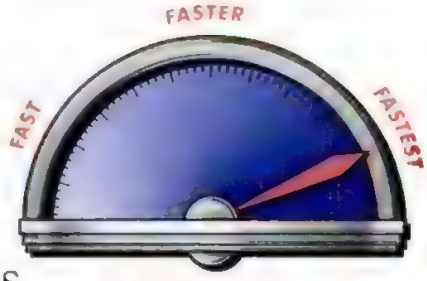


well. But are the prices really that good?

Yes. *Absolutely Yes!* The prices really *are* that good, and the quality too. Because when you buy from ZEOS you're buying directly from the manufacturer. Starting with the main system board, your new computer is designed and built by us right here in Minnesota. That saves money for you. And your ZEOS factory direct advantages are evident not only in the price, but in the performance and quality of your system too.



Z•SPEED METER

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386-33	$2095
386-25	$1995

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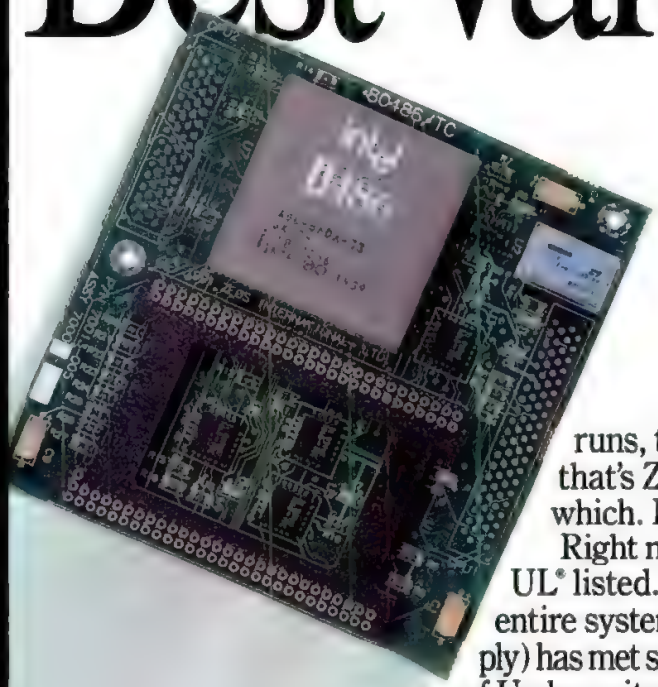

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runs, the longer it will last. Now that's ZEOS *value*. Speaking of which. How about UL® listings?

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486SX-20 $3195
386-33 $3095
386-25 $2995

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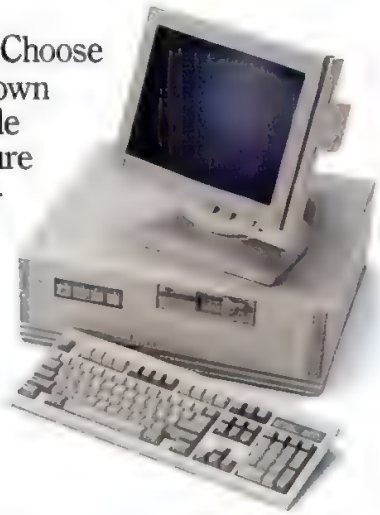

Buying your new ZEOS system is perhaps the best purchase decision you'll ever make! Simply pick up the phone and give us a call now. Incredible ZEOS power awaits you! *Call now Toll Free, 800-423-5891.*

For Complete Processor and Package Pricing, simply turn the page!

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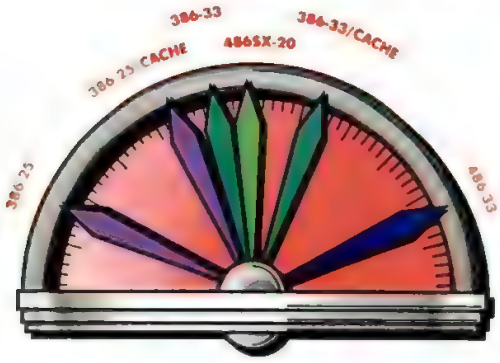

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Your #1 Choice!

ZEOS ADVANTAGES:

while others are subtle yet critical to your ultimate satisfaction. We'll go over them here with you one by one.

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QuickC for Windows: All the Pieces Minus Some Glue

HANDS ON
by Ray Duncan

Microsoft Corp. has been evangelizing graphical user interfaces for a long time, but its own languages division has been slow to get the message. *Windows* has been on the market for six years, yet all of Microsoft's mainstream programming editors, compilers, and debuggers have remained staunchly character-based. Microsoft's Visual Basic is merely an exception that proves the rule: it was largely developed by Microsoft's applications division.

As a true graphically based programming platform, QuickC for *Windows* is something of a milestone for Microsoft, even though it is long overdue and lacks some important features.

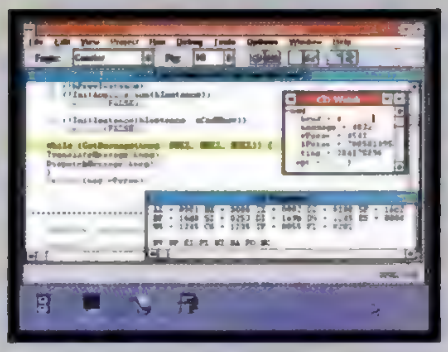
The program has four major components. The first is an integrated development environment consisting of an editor, debugger, and project manager that all work within the same main, or "frame," window. The environment supports Microsoft's multiple-document interface (MDI), so you can open child windows within the main window, view CPU registers and the values of variables while debugging, and so on. Buttons on the "Toolbar" make it easy to build a module or an entire project, set watchpoints and breakpoints, and single-step through code with simple mouse clicks.

The editor is smart about C syntax and displays C keywords, user-created function names, and comments in different colors. On-line help for any keyword, runtime-library function, or *Windows* API function is available while editing. The debugger runs side-by-side with the application on the *Windows* desktop and supports breakpoints on expressions, breakpoints within message handlers, and similar modern conveniences. The project manager knows about the different types of files needed to build an application and launches the appropriate tools automatically. The compiler does not perform optimization; however, it does run in Protected mode and can handle very large programs compared with the QuickC for DOS compiler.

The Dialog Editor and the Image Editor modules are significantly enhanced descendents of the Dialog Editor and the SDKPaint program in Microsoft's *Windows* SDK. The Dialog Editor lets you pick controls from a floating palette and then position, size, and align them with the mouse. The Image Editor is used to design icons, cursors, and other bitmaps. Both programs have the same classy 3-D look found in Visual Basic, and the scripts generated by the new version of the Dialog Editor are actually almost readable.

The last major component is an application design tool called *QuickCase:W*, licensed from CaseWorks of Atlanta, Georgia. You can use *QuickCase:W* to design an application's windows and menus visually and interactively, hook menu items to dialogs that were previously designed with the Dialog Editor, and then instruct *QuickCase:W* to generate a C-language "skeleton" as well as its header files, resource script file, and module definition file. You must then return to the integrated development environment's editor and insert the code for the actual logic of your application into the skeleton produced by *QuickCase:W*.

One other notable feature is the QuickWin library. This library can be linked with the source code for a traditional DOS program, to yield an application that runs in graphics mode and whose text output is captured in a movable, resizable window. Although the QuickWin library seems to provide a painless migration path for character-oriented DOS applications, the extent of the migration is severely limited. Once you've converted a DOS program into a QuickWin program, there's no provision for incrementally enhancing it into a true *Windows* application that takes full advantage of fonts, menus, and dialogs.



Debugging a *Windows* application with the QuickC for *Windows* integrated debugger.

QuickC for *Windows* is disappointing on several levels. First, the documentation is fragmented and inconsistent. It seems that most of it was simply packaged from preexisting QuickC for DOS or *Windows* SDK reference materials without any serious attempt to make it all hang together.

Second, the level of software integration leaves a lot to be desired. The four primary modules do not communicate with each other and are ignorant of each others' actions. If you create a new dialog with the Dialog Editor or a new icon with the Image Editor, you must manually tell *QuickCase:W* and the project manager if you want to merge it into your program.

Third, QuickC for *Windows* does not include fundamental tools that are crucial to serious *Windows* program development. The missing tools include, but are not limited to, Heapwalker, Shaker, the Help Compiler, a screen snapshot utility, and the debugging version of the *Windows* kernel. It's also a shame that Microsoft didn't provide a way to reconfigure QuickC's project manager so that QuickC's nonoptimizing compiler could be replaced with Microsoft's Optimizing C Compiler, Version 6.0, for users who own both compilers.

Lastly, Microsoft has not provided libraries that give the programmer leverage on the complex *Windows* API (other than the QuickWin library, which does not produce a true *Windows* application); even the inclusion of *QuickCase:W* seems halfhearted. The package's two manuals don't discuss *QuickCase:W*, and the example programs are not set up for use with *QuickCase:W*.

In summary, QuickC for *Windows* represents a significant step forward in ease of use compared to previous Microsoft C products. However, most of its features are long overdue, its support for *Windows* programming is primitive compared to the elegant paradigm presented by Visual Basic, and its resource design tools are marginal compared to Borland's Resource Workshop or the Whitewater Resource Toolkit.■

FACT FILE

QuickC for *Windows*
Microsoft Corp., 1 Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080.
List Price: $199; upgrade from Microsoft C Version 6.0 or Microsoft QuickC for DOS, $89.95.
Requires: 286-based PC or better, 2MB RAM, 6MB hard disk space, DOS 3.1 or later. *Microsoft Windows* 3.0 or later running in Standard mode or 386 Enhanced mode.
In Short: Microsoft's graphically based C-language programming environment for *Windows* 3.0 is long overdue and could be better integrated.

CIRCLE 449 ON READER SERVICE CARD

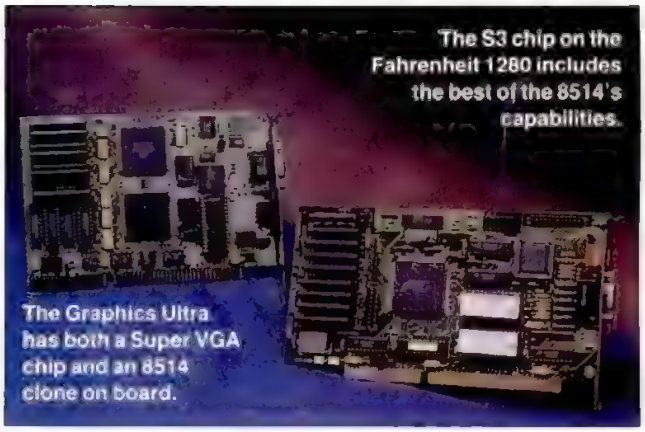
Boards from ATI and Orchid Prove Worthy of "Windows" Accelerator Moniker

HANDS ON
by Ben Myers

If you use *Microsoft Windows* regularly and find yourself watching your screen repaint at a snail's pace, then consider the Graphics Ultra and Fahrenheit 1280 video cards, the first of a new breed of affordable *Windows* accelerator cards optimized for *Windows* (see sidebar). Both deliver snappy *Windows* graphics that far outpace the fastest Super VGA cards.

Each gains its performance from a combination of a high-speed graphics coprocessor and video random access memory (VRAM). Unlike less expensive and more common dynamic random access memory (DRAM), VRAM is dual-ported. With VRAM, the video coprocessor writes data to VRAM and the video RAMDAC reads data from VRAM at the same time. The advantages of VRAM are twofold: faster graphics performance and support for 70-Hz and 72-Hz monitor refresh rates that are easy on the eyes.

Both cards use similar graphics coprocessors. ATI's Graphics Ultra graphics coprocessor is register-compatible with IBM's original 8514 chip and extends the 8514's capabilities. Orchid's Fahrenheit 1280 is built around the S3 Carrera chip, which includes the most vital 8514 register commands.



The S3 chip on the Fahrenheit 1280 includes the best of the 8514's capabilities.

The Graphics Ultra has both a Super VGA chip and an 8514 clone on board.

PHOTOGRAPHY: THOM O'CONNOR

Though similar, these cards have their differences. In addition to the graphics coprocessor, the ATI card houses ATI's VGA chip, 256K of dedicated VGA memory, a mouse port, and a Microsoft-compatible mouse in a card that is only 6 inches long. Installation is a snap because the setup software indelibly records information about monitor type, bus width, and mouse specifics into EPROM on the card. When you reboot, the Graphics Ultra reads its EPROM and initializes itself accordingly.

ATI supplies 256 color *Windows* drivers at 800-by-600 and 1,024-by-768 resolutions. At the latter resolution, there are three drivers; one uses small fonts that are appropriate for use with a 19-inch monitor; a second has standard 8514 fonts; the last incorporates ATI's Crystal fonts anti-aliasing technology to make on-screen text easier to read. In addition to *Windows*, ATI includes software drivers for *AutoCAD*, *GEM*, *Lotus 1-2-3*, and *Ventura Publisher*. ATI also sells the Graphics Vantage ($499) which is functionally identical, uses only DRAM, and runs slower than the Ultra.

Orchid's Fahrenheit 1280 represents slightly newer technology, and the preview version of card and driver proved to be slightly less polished than the Graphics Ultra. The Fahrenheit 1280, an 8-inch card with VRAM, uses a single video chip (the S3 Carrera), which provides VGA compatibility and adds the bit block transfer (BitBlt) and line drawing features of the IBM 8514 chip.

The Fahrenheit 1280 has switches to select monitor refresh rate and to enable a speed booster. The latter enables the card to access the PC bus with zero wait states, giving an added boost to performance. There is also a jumper for motherboard compatibility, to work around nonstandard bus timing signals.

The *Windows* drivers for the Fahrenheit require changing a jumper on the card to switch between 16- and 256-color palettes. Orchid has plans to deliver separate drivers for each color depth soon. Though the S3 Carrera chip and the AMI VGA BIOS claim to be fully compatible with the VGA specification, the Fahrenheit 1280 would not work with the *Windows* standard VGA driver when tested in PC Labs. However, it performed flawlessly with a sampling of other VGA software. Orchid also includes drivers for *AutoCAD* and *WordPerfect* 5.1.

Orchid intends to make available a Fahrenheit upgrade kit with a Sierra RAMDAC and 32,768 color *Windows* drivers. A *Windows* 3.0 driver supporting 16 colors at 1,280-by-1,024 resolution is also currently in development.

When tested with Version 2.0 of the PC Magazine Labs *Windows* benchmark tests on a 33-MHz 80486, both cards consistently outperformed two of

CONTINUES ON PAGE 52

PERFORMANCE TESTS: ATI GRAPHICS ULTRA, ORCHID FAHRENHEIT 1280

The similar scores of the ATI and Orchid boards on the relatively simple Draw Horizontal and Draw Diagonal Lines tests indicate that the hardware performance of these two adapters is quite close. However, ATI's superior performance on the more computation-intensive BitBlt and Random Rectangles operations is largely attributable to ATI's better video drivers, which are now more advanced than the relatively new Orchid drivers.

GRAPHICS PERFORMANCE TESTS FOR WINDOWS 3.0

Throughput
(millions of pixels per second)
Higher scores represent better performance.

	Aligned BitBlt	Non-aligned BitBlt	Draw Horizontal Lines	Draw Diagonal Lines	Random Rectangles
ATI Graphics Ultra	21.5	19.8	9.6	7.3	53.6
Orchid Fahrenheit 1280	10.9	10.5	10.1	6.7	25.0
Diamond SpeedStar Plus	1.8	0.9	3.0	1.1	5.3
NDI Volante	12.0	11.5	5.7	1.8	6.1

The **Aligned** and **Nonaligned BitBlt** tests draw a 256-by-256 pixel square and use the *Microsoft Windows* 3.0 function BitBlt (bit block transfer) to move it from one screen location to another—which is similar to moving a cursor, icon, or window across the screen. Using nonaligned BitBlts requires far more CPU overhead because it is necessary to compute the screen memory offset position.

The **Draw Horizontal** and **Draw Diagonal Lines** tests use the *Windows* 3.0 LineTo function to draw lines on-screen. For noncoprocessed boards, diagonal line draws are far more CPU-intensive, since both *x* and *y* coordinates are incremented

The **Random Rectangles** test measures the time it takes the graphics adapter and driver to draw a series of random rectangles, which is a common *Windows* operation used in drawing title bars and menus.

We performed all tests using *Microsoft Windows* 3.0 in 386 Enhanced mode on a 33-MHz 80486 EISA system with 16MB RAM and 64K memory cache, running at 1,024-by-768 resolution with 256 colors.

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Special DOS 5 support	✔		
Converts Ext to Exp.*	✔	✔	✔
Relocates to High-DOS	✔	✔	✔
Relocates to LIM 3.2 Frame	✔		
Relocates to Expanded	✔		
Relocates to Extended	✔		
Works on 386/486	✔	✔	✔
Works on 8088/286	✔		
Memory Analysis Utility	✔		

*Requires NEAT CHIPSet on 286 systems.

[illegible] DOS 5 [illegible]

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†To support all of NETROOM's features on 8088/286 PCs you will need NEAT CHIPSet or expanded memory hardware.

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Graphics Adapters

CONTINUED FROM PAGE 50

the fastest Super VGA cards, the Diamond SpeedStar Plus and the ATI VGA Wonder XL. In the BitBlt, line drawing, and rectangle filling tests, the Graphics Ultra ranges from 3 to 12 times faster than the Diamond card. The Fahrenheit 1280 is 2 to 10 times faster than the Diamond card for the same set of tests.

In reporting the performance scores in the table on page 50, we listed the ATI Graphics Ultra first, since its performance was best. ATI's graphics adapter features both a VGA chip and coprocessed video, its enhanced 8514 chip.

The Orchid Farenheit 1280, as mentioned above, adds some 8514 features to the basic VGA chip, placing it in the middle of the development spectrum. More than just featuring the frame grabbing functionality of the Diamond Speedstar Plus with its Tseng Lab's ET4000 chip, Orchid's S3 chip performs some of the necessary computations, as opposed to standard CGA and Super CGA, where those instructions are performed by the CPU.

Both cards generally matched or bettered the NDI Volante, a video card with both Texas Instruments' 34020 (a graphics coprocessor) and the Tseng ET-4000 graphics engines. Our tests were run on a 486 PC; those with slower machines should see even greater relative performance improvements.

If you are willing to pay a little more for slightly higher performance and can use the slot saved by a built-in mouse, the ATI Graphics Ultra makes for snappy *Windows* graphics. If your budget is more modest, the Fahrenheit 1280 will show a significant improvement in *Windows* performance when compared with the current crop of Super VGA adapters. ■

List Price: Graphics Ultra, with 512K VRAM, $699; with 1MB VRAM, $899. **Requires:** ISA- or EISA-bus PC and compatible video monitor. ATI Technologies Inc., 3761 Victoria Park Ave., Scarborough, Ontario, Canada, M1W 3S2; 416-756-0718.

CIRCLE 449 ON READER SERVICE CARD

List Price: Fahrenheit 1280, with 512K VRAM, $449; with 1MB of VRAM, $499. **Requires:** ISA- or EISA-bus PC and compatible video monitor. Orchid Technology, 45365 Northport Loop West, Fremont, CA 94538; 510-683-0300.

CIRCLE 450 ON READER SERVICE CARD

AVAILABLE COMBINATIONS OF RESOLUTION AND COLOR

	Orchid Fahrenheit 1280	ATI Graphics Ultra
640 x 480 x 16	❑	■*
640 x 480 x 256	■	❑
800 x 600 x 16	■	■*
800 x 600 x 256	■	■
1,024 x 768 x 16	■	❑
1,024 x 768 x 256	■	■

■—Yes ❑—No

*At these resolutions the ATI board uses its VGA chip, and not the 8514.

A FOCUS ON ACCELERATING WINDOWS

Today's VGA and Super VGA (SVGA) technology uses a simple frame buffer with minimal built-in processing capability. The PC's processor plays a role in placing each and every pixel on screen. Moving a graphics image from one area of the screen to another requires that the processor reads data from the video frame buffer, then writes it back again. For both operations, data flows from video memory through the PC bus, into PC RAM, and back the other way.

The typical 16-bit ISA bus presents a bottleneck in moving VGA/SVGA graphics data to and fro. At higher resolutions this is exacerbated since more pixels must be managed.

The Windows environment is said to be oriented toward raster graphics, because Windows manages the screen as sets of bitmaps, painted on-screen horizontally left to right one scan line, or raster, at a time. By contrast, vector graphics dominate CAD packages like AutoCAD, which draws many vectors (straight lines drawn from a starting point to an ending point).

In the raster world of Windows there are only a few graphical operations that are used very frequently. Windows uses Bit Block Transfers (BitBlt) to copy rectangular blocks of data from one part of the screen to another, or between PC memory and screen. BitBlt variations combine old and new on-screen data to yield varying effects such as animation and highlighting. Windows also frequently draws straight lines to outline windows, list boxes, and other objects.

Less important, but still often used, are operations that fill rectangles with solid or dithered patterns, such as a window background color or the Windows desktop canvas.

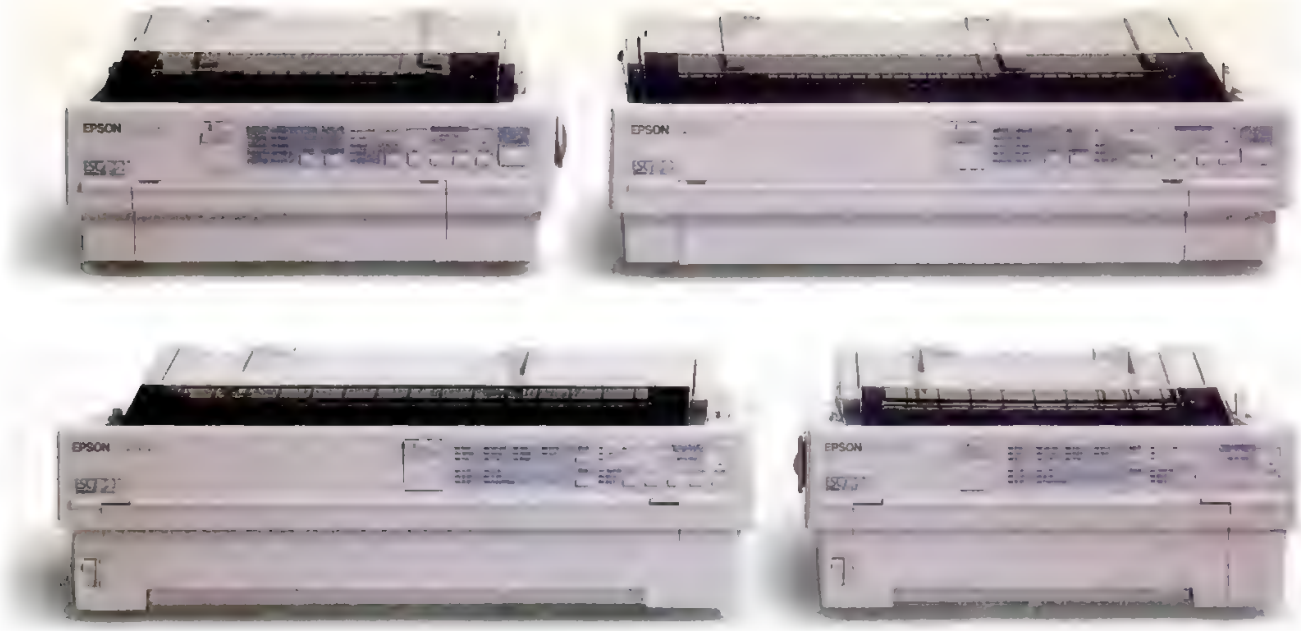
From this perspective, it's easy to construct a model for a graphics technology that accelerates Windows performance. Simply stated, a Windows accelerator handles BitBlts and line drawing autonomously once it has been commanded to do so by the PC. A Windows accelerator gets added points if it can also fill rectangles, typically with repeating 8-bit patterns.

Video cards based on the Texas Instruments 34010 and 34020 chips have long provided Windows accelerator capabilities, albeit at premium prices. The first Windows accelerator card with a more affordable price was the 8514, announced by IBM in 1987 along with the PS/2. These early Windows accelerators required a separate VGA chip, either built into a PS/2 system or present in a second video card plugged into an ISA-bus PC.

The IBM XGA chip meets Windows accelerator criteria perfectly, completely supporting basic VGA as well as XGA resolutions. ATI Technologies' answer is to clone the 8514 chip, extend its capabilities, and build cards with both Super VGA and 8514 chips onboard—the Graphics Ultra and the Graphics Vantage. The S3 Carrera chip is a single chip that combines VGA with the high- performance features of the 8514. The Orchid Fahrenheit 1280 card is the first card to use the S3 Carrera from S3 Inc. A new chip from Weitek Corp., the W5086 which will be available on various accelerator boards shortly, is expected to break new ground with a unique graphics architecture that offloads BitBlt and line-drawing operations. Other video chip solutions to the Windows acceleration problem will emerge in the coming months.

The debate about the heir apparent to the VGA standard will continue to rage. But for Windows and other graphical environments, a single standard is not as essential as you might think. More important are price, performance, and the long-term availability of drivers for Windows and other graphical environments.—BM

Presenting The Next Page In Printer History. From The Company That Printed The First.



Funny how history has a way of repeating itself. Year after year—actually for the past 25—Epson® has been the leader in dot matrix printing technology.

Introducing six reasons why that leadership is sure to continue: the letter-quality Epson LQ-570, LQ-870, LQ-1070, LQ-1170, ActionPrinter™ 5000 and ActionPrinter 5500.

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For sheer paper handling flexibility, no other printer—dot matrix, ink jet or laser—handles quite as well as these.

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When fully loaded, these printers put as many as five types of paper at your fingertips. Everything from letterhead to continuous-form checks, four-part forms, tractor-feed paper, even envelopes.

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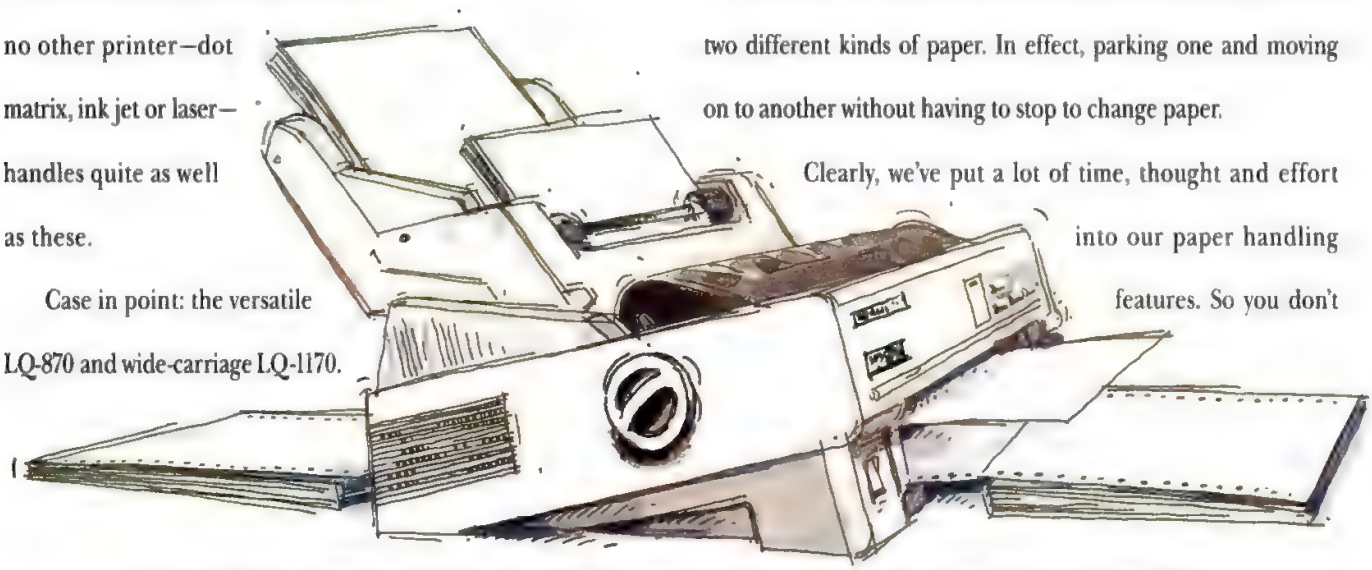
Then there's Epson SmartPark™ paper handling. At the press of a button and flick of a lever, you can easily switch between two different kinds of paper. In effect, parking one and moving on to another without having to stop to change paper.

Clearly, we've put a lot of time, thought and effort into our paper handling features. So you don't



With five different paper paths to draw from at any moment, an Epson LQ printer is as versatile as it is dependable.

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have to put much time, thought or effort into using them.

Scale New Heights.

Each new Epson printer comes with a new industry-setting standard—ESC/P2.™ This breakthrough printer control system brings scalable fonts to dot matrix printing.

Simply put, type sizes are no longer as limited. So now you can do things with a 24-pin printer that before could only be done with a laser. And you don't have to give up one bit of paper handling flexibility to do it.

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What ESC/P2 does for type, it also does for graphics. Brilliantly.

It includes an enhanced Windows™ driver, exclusive to Epson. When you print from any program running in Windows, you'll get superior output quality and faster throughput speeds.

SCALABLE FONTS

With a new Epson LQ printer, you can print a variety of type in a variety of sizes, up to 32 point.

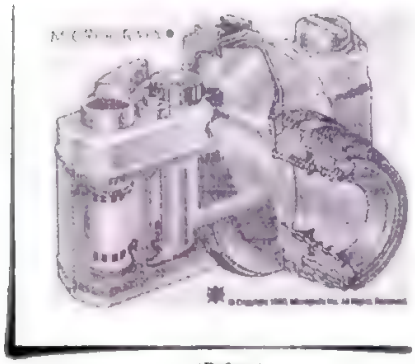
But don't just take our word for it. Take a look at the quality of our graphics instead.

Built For The Long Run.

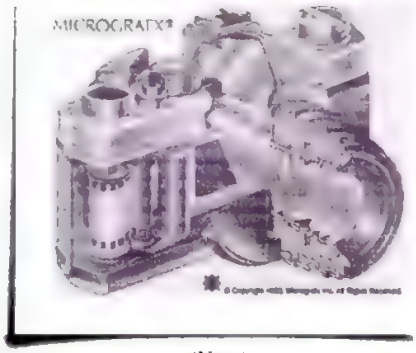
Epson printers aren't only designed with more firsts, they're designed to last. Each is backed by a generous 2-year limited warranty. As well as a helpful toll-free 800 number to provide you with dependable, expert assistance.

One more thing you can always depend on: Epson reliability. It isn't a claim just any printer company can make. It's a quality—a character trait—our products have earned over time.

To see the latest printer innovations firsthand, visit your nearby Epson dealer, or call 800-289-3776. And see why, after more than 25 years, Epson is still the first name in dot matrix printing.



(Before.)



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Epson's enhanced Windows driver improves not only the look of your text and graphics, but the speed at which they print.

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$99 ProKey Brings Macro Power to Windows

HANDS ON
by Barry Simon

ProKey was once synonymous with keyboard macros in the DOS world. With its new $99 *ProKey for Windows*, RoseSoft has arisen like the phoenix, making a play to be the standard-bearer for macros in the *Windows* world.

ProKey differs from *Windows* batch languages (such as Softbridge's *Bridge Batch* and Symantec's Batch Runner in the *Norton Desktop*), which record only keystrokes, and from other macro languages (such as *Windows'* own Recorder and Affinity Software's *Tempo*), which allow you to record mouse actions but do not allow you to edit macros.

With its ability to edit (however limited) and its true *Windows*-based event recorder, *ProKey* is the first serious macro program for *Windows*. But as *ProKey* is treading on new ground, it lacks the flexibility of a fully matured product.

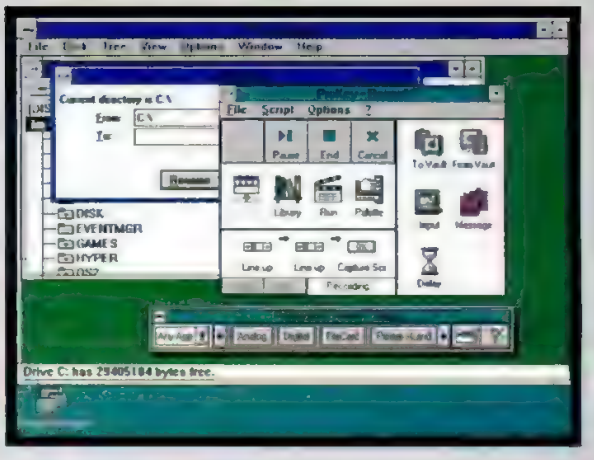
While *Windows* does not have or need TSRs, *ProKey* acts just like a conventional macro program in that it gets loaded before other *Windows* applications. *ProKey* monitors actions in those *Windows* applications—but not in DOS programs running under *Windows*.

You can use hotkeys to run and record macros, or you can switch to *ProKey*'s main window and use its menus to send keystrokes to the application you were focused on before it. Or you can use buttons in a special *ProKey* window that floats above any *Windows* application. The buttons in this "palette" can have assigned text but cannot be assigned icons.

Macros can include delays, messages to the user, or input strings to be passed through to the application. They cannot, however, include the date or time. You can also use *ProKey* as a supplement to the *Windows* Clipboard to make transfers between applications. The Clipboard can only store one item, but *ProKey* provides multiple "vaults," so you are enabled to record a macro that might pick up several different numbers in *Microsoft Excel* and later paste them into *Ami Pro*.

ProKey focuses on events, not keystrokes. For example, the program records the state of dialog boxes, so you can instruct the macro to turn on, to turn off, or to toggle a given check box. The downside of this approach is that many *Windows* applications have idiosyncrasies. For instance, we discovered some perfectly reasonable macros that ran properly in *Write* but not in Paintbrush, and vice versa.

Macro editing is done in trace mode, *ProKey*'s most intriguing feature. Scripts are broken into individual actions such as starting or minimizing an application, making a menu choice, or hitting a single key combination. Four actions are displayed as icons in the trace window at one time.



***Prokey for Windows* lets you record complex *Windows* events such as dialog box actions.**

ProKey does not view a string of text as a single "action" that you edit as a whole. Instead, *ProKey* views each character as a separate action. Therefore, to insert three characters you have to hit the Insert Action button three times, once before each character. You cannot edit any individual action, but you can delete and insert actions in the chain.

While *ProKey*'s edit procedure is awkward and does not let you edit a macro without running it, the program still gives you a degree of control over script recording and editing that is not possible with any other program. *ProKey for Windows* is a promising first version of an extremely useful utility. Many *Windows* users will find it indispensable immediately; all should look for the next version. ■

List Price: *ProKey for Windows*, Version 1.0, $99. **Requires:** *Microsoft Windows* 3.0. RoseSoft Inc., P.O. Box 70337, Bellevue, WA 98007; 206-562-0225.

CIRCLE 445 ON READER SERVICE CARD

Test Drive Your Software on CD-ROM

HANDS ON
by Nate Zelnick

Finding the perfect program for yourself or your company can take hours, if not weeks, of research. And then there's always the chance that the database or spreadsheet package that looked so good will turn out to be the wrong one for you—after hours of installation and training.

Computer Library, a division of *PC Magazine*'s parent company, Ziff-Davis, has the software shopping solution. *Select Demos*, a CD-ROM based application, offers screenshow-like demos and models of 1,145 applications.

At $149 it is a compilation of the demos sent to prospective buyers. *Select Demos* offers them in a compressed format, archived and accessible using a search engine.

The engine lets you search the CD-ROM by product name, type of application, price, company name, or any combination thereof. You can also search by any word used in the summary of product functions.

A search results in an in-depth fact file including hardware requirements, product functions, company, and pricing that you can print to a file or printer. In searching for PC-to-PC connectivity products under $149, for example, *Select Demos* responds in seconds with 11 products.

Downloading the demos from the CD-ROM is the application's weakest aspect. Because it will only decompress demos to floppy disks, you have to go through two PC bottlenecks—the CD-ROM and the floppy disk drives—before installing a demo on your hard disk. This makes the process excruciatingly slow. If you're going to download all products in a category for comparison, be prepared with a couple of disks and plenty of time.

Barring that, *Select Demos* gives you a quick and inexpensive way to shop for software, from Accounting to Word processing and from Abelson Communication to Zylab Inc. ■

List Price: *Select Demos*, $149. **Requires:** CD-ROM drive, 640K RAM, 2MB free storage, DOS 3.1 or later. Computer Library, 1 Park Ave., New York, NY 10021; 212-503-4400.

CIRCLE 709 ON READER SERVICE CARD

The Great Crash Of '91.

Not long ago, the PC world was shaken by the news that a surprisingly well-known communications package had crashed while attempting high-speed file transfers. It was not a pretty sight.

After testing different comm programs, the editors of *PC Magazine* reported that *"Procomm Plus®* locked up several times during our testing of high-speed file transfers. During our Character-based ZModem tests, on an 8-MHz AT equipped with a 16550A UART, it consistently froze at every port speed faster than 38.4 Kbps on the receiving side of the link."

This episode proved that you can't be too careful before investing in comm software. It also proved, once again, that you can't go wrong with Crosstalk®.

Crosstalk Cruises Through High-Speed Tests.

Not only was Crosstalk the one consistent benchmark throughout the

PC Magazine tests, but it was one which the editors of *PC Magazine* applauded for performance, price and flexibility.

As for the feature-rich Crosstalk Mk.4, the editors commented that "...it's a real bargain for all it accomplishes. Corporate managers who require features like a powerful script language, a variety of terminal emulation selections, and network communications capabilities will appreciate this product."

The editors of *Software Digest* drew a similar conclusion. They gave Crosstalk Mk.4 the only 4-star rating in their ranking of communications packages. And while Crosstalk Mk.4 proved to be an unparalleled program for power users, its sister product, Crosstalk Communicator, also scored highly in the *PC Magazine* tests.

Crosstalk Communicator received points for "...matching its higher-end sibling, *Crosstalk Mk.4*, practically score for score." It provides "...a fast, flexible alternative for the budget-conscious, particularly anyone in an organization already using *Crosstalk Mk.4*, because it can use scripts developed in that program."

Between the two of them, Crosstalk Mk.4 and Crosstalk Communicator can cover virtually any communications need you have.

Why Risk It?

So, before you risk a high-speed crash, take some free advice. Get our free reprint of *PC Magazine's* comm software round-up (including the tests with high-speed file transfers) plus helpful information on choosing the right software for your particular needs.

Just call
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CROSSTALK

Another Communications Solution From DCA®

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CIRCLE 278 ON READER SERVICE CARD

How To Avoid A High-Speed Comm Crash.

TagWrite Enforces Consistent Publishing Style

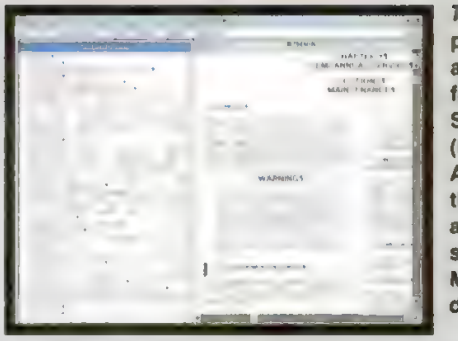
HANDS ON
By James Karney

The most tedious chores in electronic workgroup publishing are placing formatting codes in text files and ensuring consistent style in large documents. *TagWrite for Windows*, a $395 program from Zandar Corp., automates both. It acts as an intermediary universal parser accepting word-processing source code and translating it into a marked-up word processing file.

TagWrite has two components: a sophisticated parser that reads ASCII, RTF, or *Word Perfect* files, and a template that contains instructions for the parser. Created with the program's Template Editor, each template has a series of two-part rules for manipulating the contents of the document. The first part identifies text, tags, word processing commands, and style codes. The second part provides instructions for converting the text into headlines, complex tables, numbered lists, footnotes, or any other type of document format.

To begin *TagWrite*'s process, you create a document in your word processor using arbitrarily assigned commands such as "tab" or "boldface" to identify a block of text. You then load *TagWrite*, which reads the file, compares it to its user-defined template, and automatically creates a new file including the formatting. For example, a pair of tabs in your word processing file can be converted into a *numbered list automatically. Or you can insert* boilerplate text that was not in the original file. You can then import this new, ready-to-print file into target applications. The program is optimized for use with *Ventura Publisher*, *Interleaf*, and *PageMaker*.

TagWrite comes with a sample template that is easily modified. The built-in editor and debugger let you design new templates, a procedure that requires about the same skill as you need to construct an average spreadsheet. An optional Styles module lets you construct templates directly from *Microsoft Word* and *WordPerfect* stylesheets.



TagWrite's parser reads an ASCII file containing SGML tags (left window). At right is the file after conversion to a Microsoft RTF document.

The program also automatically searches a file or group of files and inserts tagging codes for Xerox's *Ventura Publisher*, *Aldus*'s *PageMaker*, and the Standard Generalized Markup Language (SGML), an international standard for defining document structure. *Tag Write* can also create untagged versions of documents so you can easily edit, preview, and proof.

More-complex *TagWrite* procedures can create an index or convert database files into tables. One drawback is the lack of support for mathematical equations. Zander Corp. also offers a $395 DOS version of the program, but it doesn't work with multiple open windows. ■

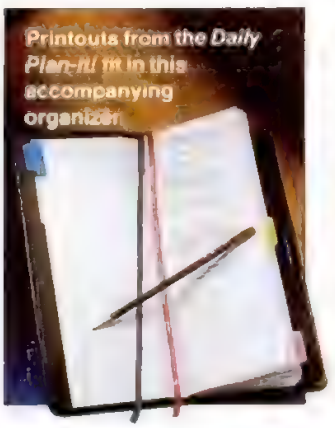
List Price: *TagWrite for Windows*, Version 3.0, $395; $49 for optional Styles module. **Requires:** *Microsoft Windows* 3.0 or later, a supported word processor. Zandar Corp., P.O. Box 480, Newfane, VT 05345; 802-365-7022.

CIRCLE 446 ON READER SERVICE CARD

The Daily Plan-It! A PIM To Take with You When You Go

HANDS ON
By Tom Ginger

mBAllen's *The Daily Plan-It!* (Plan-It) ($89.95) offers the standard retinue of PIM features, along with two conveniences you won't find in other PIMs. By letting you launch other DOS applications from within it, *Plan-It!* offers a simple integrated approach. You can also take *Plan-It!*'s printouts with you in the accompanying organizer wallet.



Printouts from the *Daily Plan-It!* fit in this accompanying organizer.

The program includes five modules—Calendar; People; Blackboard (for ASCII notes, exportable to word processors); Reports; and a Tools module that offers file backup and restoration, file repair (for corrupt database entries), and system setup commands. The DOS interface is functional, but far from slick.

Plan-It! uses a proprietary scheme called dynamic link interface (DLI) to link the data in your PIM with files in other applications. For example, you can link people in your PIM with companies in a database or documents in a word processor.

Although somewhat kludgy, DLI also lets you launch other applications while you're working in *Plan-It!* In the Product Setup screen, you enter the file name and location of the applications (DOS or *Windows*) you want to access. Then, for each client in the People module, you establish a card file that lists by filename and location its related documents and spreadsheets. The next time you select this client, highlight one of the files you listed. *Plan-It!* launches the application and takes you to the appropriate file. When you quit the application, you return to *Plan-It!*.

One external feature you won't find in any other PIM is a vinyl organizer wallet that holds up to 40 pages of addresses, phone numbers, notes, and appointments. (Leather-bound wallets are available for $29.95.) Export features let you create output for formats such as *Filofax* or *Dayrunners*.

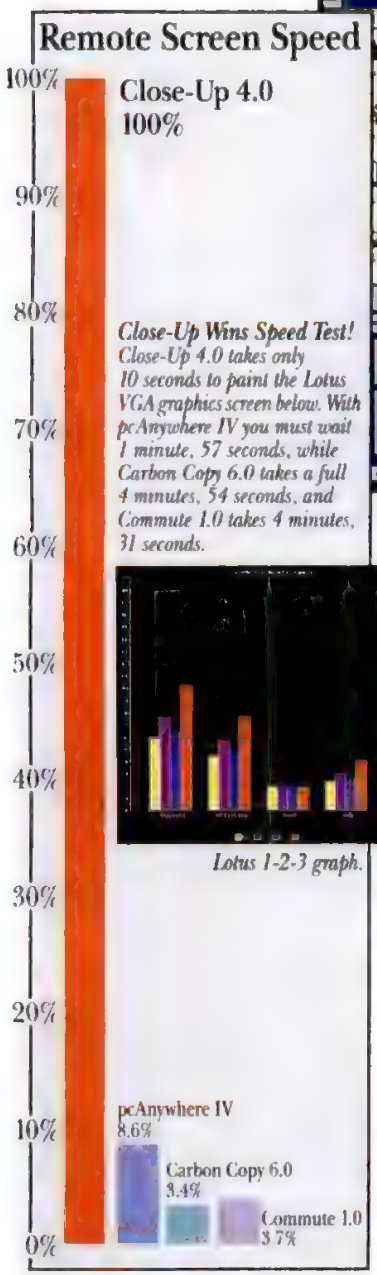
Although you can't group people into categories, as in *Instant Recall*, you can keep separate company files. And *The Daily Plan-It!*'s Quick-Pick feature creates appointment and to-do lists associated with individual clients. It also handles mail merge, prioritizes tasks, resolves scheduling conflicts, adds recurring events, and has auto-dial. *PKZIP* is included to enable you to compress and uncompress documents. A TSR version will be ready momentarily; a *Windows* version is in the works. ■

List Price: *The Daily Plan-it!*, Version 1.0, $89.95. **Requires:** 640K RAM, DOS 2.0 or later. mBAllen, 1430 Massachusetts Ave., Suite C, Cambridge, MA 02138; 800-786-9161, 617-292-6494.

CIRCLE 704 ON READER SERVICE CARD

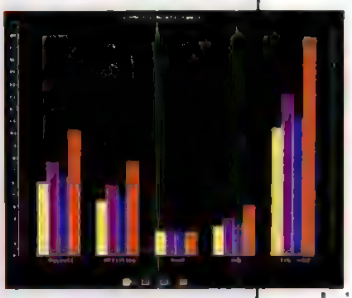
Now Supports Windows & DOS

New Close-Up the Remote with Record-Breaking Speed

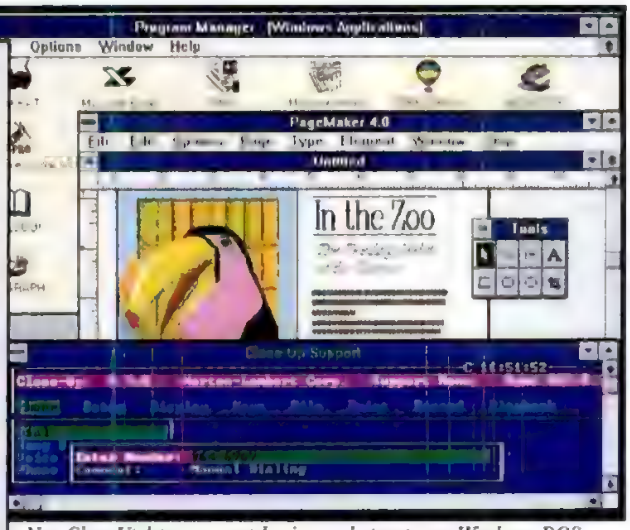


In the time it takes Close-Up to paint 100% of the above Lotus VGA graph, pcAnywhere IV has painted just 8.6%, Carbon Copy 6.0 has painted just 3.4% and Commute 1.0 has painted just 3.7% of the graph.

Close-Up Wins Speed Test! *Close-Up 4.0 takes only 10 seconds to paint the Lotus VGA graphics screen below. With pcAnywhere IV you must wait 1 minute, 57 seconds, while Carbon Copy 6.0 takes a full 4 minutes, 54 seconds, and Commute 1.0 takes 4 minutes, 31 seconds.*



Lotus 1-2-3 graph.



New Close-Up lets you remotely view and operate any Windows, DOS, or graphics application on PCs all over the world.

First with Windows and Fast Graphic Speed.

New Close-Up 4.0 is the *first* remote technology that lets you remotely view and control any Windows[‡] or DOS application on another PC miles away.

We first introduced remote communications in 1980, and developed virtually every major feature that's now the standard for remote technology.

Today Close-Up is licensed by industry leaders including 3Com, Ashton-Tate, Borland, DEC, Hewlett-Packard, IBM, Lotus, Microrim, Novell and Tektronix.

Proof that Close-Up is Fastest.

You can prove how fast new Close-Up really is: *Take the Close-Up Challenge.*

Reproduce our test[†] and see for yourself that new Close-Up 4.0 is the fastest remote program.

We took a standard VGA color graph from Lotus 1-2-3 and compared the top 3 remote programs—Close-Up, Carbon Copy, and pcAnywhere—to see how long each would take to paint a graphic screen. The results were *very* convincing. Read on!

No more waiting for your screens to paint! *Close-Up lets you work faster, more productively with the fastest screen refresh, interaction and response time ever seen!*

To paint the Lotus graphic pcAnywhere IV took 1 minute, 57 seconds. Almost 2 minutes. That's like having to sit through *four* TV commercials.

Carbon Copy 6.0 took a full 4 minutes, 54 seconds. Almost 5 minutes. That's like waiting through *five* traffic lights.

How fast did Close-Up paint it? The results will astound you. *10 seconds.*

That's right. 10 seconds is all Close-Up took to paint the screen and let you continue working.

Take the Close-Up Challenge.

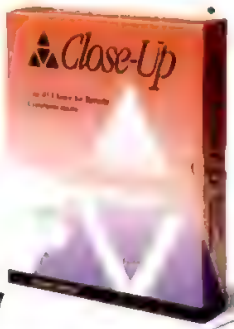
Try it for yourself. If you're not absolutely convinced that Close-Up 4.0 is the fastest remote program, *we'll give you your money back.**

Risk-Free Introductory Offer!

Now for a limited time you can get your new **Close-Up 4.0 Dual Pack**, including both sides, Customer/Terminal & Support/ACS, for only **$199.** That's a savings of over $240 and includes our **Risk-Free, 30-Day Money-Back Guarantee!***

Upgrade Now!

Upgrade your current remote program to new Close-Up 4.0, the fastest remote around. Get Customer/Terminal or Support/ACS **for only $49 each!***



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[†]We invite you to reproduce our Remote Screen test. The graph used was a color VGA graph found in Lotus 1-2-3 Release 2.2, on the "Sample Files Disk." The file is TUTOR9X.WK1. The PCs were Everex 16 MHz 386/SXs and the modems Hayes 2400 baud Smartmodems. The baud rate was 2400.

[‡]Only Close-Up passes the Windows test. 1. Total remote keyboard and mouse support in all Windows modes: 386 Enhanced, Standard and Real. 2. Remotely run multiple Windows applications and multiple (full screen or windowed) DOS applications simultaneously. 3. Use a mouse to remotely cut & paste between windowed DOS applications and Windows applications.

*30-Day Money-Back Guarantee if purchased directly from Norton-Lambert. Offer expires 12/31/91. Offer limited to one per customer. All prices in US Dollars. Prices exclude shipping. ©1991, Norton-Lambert Corp.

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FALCON 386/33

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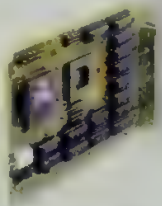
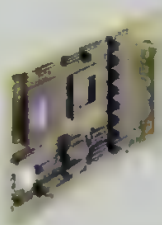
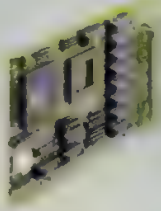


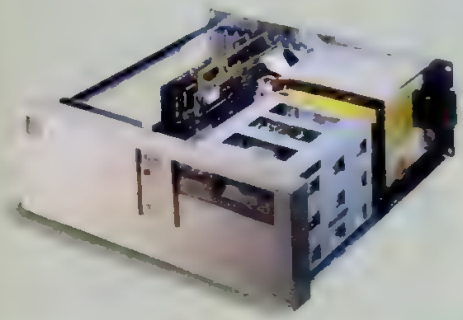
FALCON 386/25



FALCON 486/25



FALCON 486SX/20



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CIRCLE 238 ON READER SERVICE CARD

by Nate Zelnick

New & Improved

News of Announced Products and Upgrades

TEAC Ships Half-Height Dual Floppy Disk Drive

NEW **TEAC America** is now shipping the world's thinnest 3.5-inch floppy disk drive. With a height of half an inch, the FD-05 offers single-chip electronics, dual-head carriage assemblies, and direct-drive spindle motor.

Although the drive is meant for laptop manufacturers, it will be sold directly to consumers in combination with TEAC's new FD-155 1-inch-high 5.25-inch floppy disk drive to create a half-height dual-floppy-disk system. The dual system, called the FD-505, squeezes both drives into one bay by using a special mounting bracket.

TEAC has also announced a 3.5-inch multifunction optical disk drive. The OD-3000 features a 128K buffer for increased throughput. Like the drives recently announced by both IBM and Sony, the OD-3000 will accept both rewritable and O-ROM (optical read-only memory) media.

List Price: FD-505, $120; OD-3000, $890. **Requires:** For the FD-505, a standard floppy disk controller; for the OD-3000, a SCSI adapter. TEAC America Inc., 7733 Telegraph Rd., Montebello, CA 90640; 213-726-0303.

CIRCLE 436 ON READER SERVICE CARD

TEAC has squeezed full-function floppy disk drives into tiny packages, available as dual drives in half-height cases.

Stacker Squeezes Out More Disk Space, Adds New Boards

IMPROVED **Stac Electronics** has released an upgrade to its data compression software, a 16-bit version of its compression coprocessor board, and support for a wide variety of storage media.

Version 2.0 of *Stacker* offers a fine-tuned installation procedure that adapts to your DOS version and makes necessary corrections to storage media. The program now occupies only 9K of RAM.

Stac's 16-bit ISA and MCA coprocessor boards operate up to 30 percent faster than the original XT boards. *Stacker* now supports storage to floppy disk drives, RAM disks, and Iomega's Bernoulli disks.

List Price: *Stacker*, Version 2.0, $149; Stacker XT/8, $199; Stacker AT/16, $249; Stacker MC/16, $299. **Requires:** 14K RAM; open XT, AT, or MCA slot; DOS 3.0 or later. Stac Electronics, 5993 Avenida Encinas, Carlsbad, CA 92008; 800-522-7822, 619-431-7474.

CIRCLE 437 ON READER SERVICE CARD

Epson Introduces Low-Price Laser Printer

NEW **Epson America,** a dot matrix printer leader, has targeted its ActionLaser II at first-time laser printer buyers. The 300-dot-per-inch, 6-page-per-minute printer costs $995 and comes with 512K of RAM (upgradable to 5.5MB using standard DRAMs) and a 100-sheet paper tray.

The printer has slots for both HP cartridges and Epson's own credit card–style IC slot. Epson and HP LaserJet IIP emulations are standard. HPGL and Adobe PostScript emulations are available on IC cards.

The ActionLaser has a straight-through paper path, allowing the printer to accept heavier stock paper, labels, and envelopes with less jamming. An auto-switching function allows simultaneous connection through both parallel and serial ports, as well as through an optional coaxial/twinaxial connector.

List Price: ActionLaser II, $995. **Requires:** Parallel or serial port. Epson America, 20770 Madrona Ave., P.O. Box 2842, Torrance, CA 90509-2842; 800-289-3776 ext. 1000, 213-782-0770.

CIRCLE 434 ON READER SERVICE CARD

Presentations for Nonprofessional Graphics Producers

NEW **Power Up Software Corp.** has announced *Express Presenter*, a DOS-based presentation graphics package that is easier to use than higher-end professional packages, according to the company.

CONTINUES ON PAGE 62

HOT PROSPECT

HP LASER PRINTER OFFERS SPEED INCREASE, LOWER PRICE

Hewlett-Packard Co. has increased the processor speed, throughput, and start-up time of its LaserJet II. The new model, called the LaserJet IIP Plus, replaces the LaserJet IIP in HP's line.

The printer has a 16-MHz Motorola processor, as opposed to its predecessor's 10 MHz, and offers up to four times the throughput of the previous model, according to Hewlett-Packard. In addition, a new "heat-up" feature brings the printer online faster. The new printer does not offer serial or AppleTalk ports.

The IIP Plus comes standard with 512K RAM, PCL 4, and a 70-sheet multipurpose paper tray. Memory can be expanded to 4.5MB in 1MB or 2MB steps. PCL 5 cartridges are available for an added $299. The printer supports all IIP paper trays.

HP's LaserJet IIP Plus features a faster processor and a parallel port with greater throughput.

List Price: HP LaserJet IIP Plus, $1,249. **Requires:** Parallel port. Hewlett-Packard Co., 19310 Pruneridge Ave., Cupertino, CA 95014; 800-752-0900.

CIRCLE 430 ON READER SERVICE CARD

BRIEFS

PRINTERS AND ADD-INS

Alps America is now shipping a 16-page-per-minute shared laser printer, the Alps LSX1600 ($3,295). The HP Series II–compatible printer has 24 internal fonts and supports HP soft fonts and font cartridges. Its paper-handling capacity of up to 750 sheets is achieved through two paper bins. Alps has also announced a high-speed dot matrix printer, the 18-pin DMX800 ($2,195). Rated by the company at a draft mode speed of 800 characters per second, the printer is capable of outputting bar codes and OCR-A and -B standard fonts as well 11 text fonts. An auto-sensing paper-handling feature adjusts the unit for heavy stock and multipart forms. The printer emulates an Epson FX-1050 or IBM Proprinter IIIXL. 800-825-2577, 408-432-6000.

Computer Peripherals has added DeskRAM ($124.95) to its line of memory expansion products for Hewlett-Packard LaserJets and DeskJets. DeskRAM adds 256K of memory to DeskJet 500 and DeskJet Plus printers using a single cartridge that plugs into one of the two DeskJet cartridge slots. 800-854-7600. 805-499-5751.

General Parametrics has announced the Spectra Star Model 440 ($7,995), a color thermal printer with a 32MB hard disk for print-spooling of large graphics jobs and storage of font information. The 300-dpi printer uses color thermal wax. Storing Adobe PostScript fonts speeds output. An upgrade kit from the Model 430 to the Model 440 is available for $1,050. 800-223-0995, 510-524-3950.

Epson America has announced an improved version of the LX-810 ($269), its narrow-carriage 9-pin dot matrix printer. New features include 30 to 60 percent speed increases (dependent upon print resolution). The printer is rated by Epson at 240 characters per second in draft mode. 800-289-3776 ext. 1000, 213-782-0770.

Okidata is now offering a low-cost 8-page-per-minute Adobe PostScript printer. The Okidata OL830 LED Page Printer has a suggested retail price of $1,999. The printer offers auto-switching

CONTINUED FROM PAGE 61

The package organizes text and graphics files in "folders," but maintains each file individually for reuse later. Elements of a presentation may be updated globally, however. Other ease-of-use features include automatic charting, over 30 chart templates, interactive chart editing, and direct editing of speaker's notes on the storyboard.

Express Publisher supports 252 colors per chart from a palette of 16.8 million color combinations. Output can be sent to PostScript-, LaserJet-, and PaintJet-compatible printers, as well as 35-mm. digital slide recorders. It imports files in ASCII, CGM, .WKS, and .WK1 file formats.

***Express Publisher* is a DOS-based presentation graphics package that offers quick scripting power to beginners.**

List Price: *Express Presenter*, $249.95. **Requires:** 640K RAM, DOS 3.0 or later. Power Up Software Corp., 2929 Campus Dr., San Mateo, CA 94403; 415-345-5900.

CIRCLE 432 ON READER SERVICE CARD

DAT Compression System Stores 8GB

IMPROVED Using the HPLZ compression algorithm implemented on hardware, **Storage Solutions** DATa-bak8 can provide up to 8GB of storage on a single 2GB 90-meter, 4-mm. DAT (digital audio tape). In addition, depending upon the platform and software used, the compressed data can be transferred at rates up to 44MB per minute.

Because the compression is done in the drive, it is transparent to the user. Basic packages include the 3.5-inch drive (or external unit), SCSI II connector, workstation- or server-based software, five DATs, and a head cleaner. The basic package comes with Sytos's *Sytos-Plus* backup software. Enhanced kits for *NetWare* networks come with Cheyenne Software's *ARCerve* for *NetWare 286* or *386*. Packages are also available for Banyan *VINES*.
List Price: DATa-bak8, $4,995. **Requires:** Open port for SCSI adapter. Storage Solutions Inc., 417 Shippan Ave., Stanford, CT 06902; 203-969-6047.

CIRCLE 433 ON READER SERVICE CARD

OCR Software First To Use HP's AccuPage

IMPROVED **Caere Corp.**'s *OmniPage Professional* has added support for Hewlett-Packard's AccuPage technology, which provides improved optical character recognition (OCR) for poor-quality documents. Version 2.0 of this *Windows*-based software also adds advances in gray-scale image editing and text processing, as well as recognition of upside-down documents.

AccuPage, a technique currently implemented only in HP's ScanJet IIc, automatically sets optimal intensity contrasts to compensate for poor image quality in documents. *OmniPage Professional* will be bundled with the scanners.

Another enhancement includes the ability to recognize that a page has been placed in the scanner upside down; it will flip the image and then continue scanning.

The software also adds several image editing functions including a graphics editor that creates line and continous tone art with up tp 256 shades of gray, Caere's LaserGray halftone technology, as well as complex masking, selection, rotation, and inversion functions.
List Price: *OmniPage Professional*, Version 2.0, $995; upgrades, $100. **Requires:** 4MB RAM, scanner, *Microsoft Windows* 3.0. Caere Corp., 100 Cooper Ct, Los Gatos, CA 95030; 408-395-7000.

CIRCLE 431 ON READER SERVICE CARD

Package Lets Developers Add Special Effects to Presentation Graphics

IMPROVED **Genus Microprogramming** is offering *GX Effects*, Version 2.0, a special-effects software toolkit that allows developers to add more than 50 effects to their graphics applications, including wipes, fades, rolls, and spirals. In addition, the system offers support for the Sound Blaster voice-file standard, which lets developers synchronize sound with their applications.

The package also includes palette cycle and fade features, so developers can create their own effects. *GX Effects* supports CGA, EGA, VGA, and Super VGA display adapters and has compiler interfaces for assembly, BASIC, C, Clipper, Fortran, and Pascal. Source code is available for an additional fee.
List Price: *GX Effects*, Version 2.0, $199; with source code, $399. **Requires:** 512K RAM, DOS 2.1 or later. Genus Microprogramming, 2900 Wilcrest, #145, Houston, TX 77042; 800-227-0918, 713-870-0737.

CIRCLE ON 435 ON READER SERVICE

The New PC Industry Standard.
The longest-running, most comprehensive survey of PC customer satisfaction finds CompuAdd is #1.
After a full year of independent surveys, Dataquest found that PC users rate CompuAdd #1 above IBM, Compaq, Apple and 16 other major PC vendors. A Dun & Bradstreet company noted for its authoritative high-tech market research for the past 20 years, Dataquest compiled the results of more than 6000 interviews* from businesses large and small. The surveys ranked what users consider most important, including Quality, Customer Commitment and Value/Price.
What emerged was a new standard in Quality. CompuAdd won nine technical excellence awards during the last year.
A new standard in Commitment to Customers. CompuAdd also received the first-ever PC World Service Excellence Award.
And a new standard in what matters to users most, Value/Price.
At CompuAdd, we've built a half-billion dollar company committed to making PCs reliable, available and affordable. And that should satisfy just about everyone's standards.
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BRIEFS

between PostScript and other emulations by using LaserTools' *Printer Control Panel*. The OL830 comes standard with 2MB of RAM (expandable to 4MB), a Centronics parallel port, *Adobe Type Manager*, and 17 fonts. An RS-232 port is available as an option. 800-654-3282.

Genicom has released a new version of its 3800 Series dot matrix network printer. The 3840E ($2,595) offers rear and front/bottom paper paths for continuous forms and a single sheet feeder on the top. Path selection is from the host system. The 3840E is rated at 600 characters per second by Genicom. 703-949-1492.

Pacific Data Products has announced an enhanced version of its FontBank Cartridge ($299 for 3/4MB storage), a flash memory–based font storage device for HP LaserJets. The product allows you to download fonts and create custom cartridges. Version 1.1 of the product's software adds the ability to store PCL printer macros from any LaserJet Series III printer. In addition, a larger-capacity 1.5MB cartridge ($399; $75 upgrade) has been introduced. 619-552-0880.

BULLETIN BOARDS

Galacticom's latest version of *The Major BBS* adds support for log-ons through Novell *NetWare* by "hardwiring" IPX direct circuits to a workstation. Version 5.3 of the software also adds e-mail distribution lists and enhancements for sysops allowing for remote access to sysop-only functions. *The Major BBS* Standard Edition lists for $59 and allows two simultaneous users. The BBS will support up to 256 simultaneous users. A demo bulletin board is available by modem at 305-583-7808. 305-583-5990.

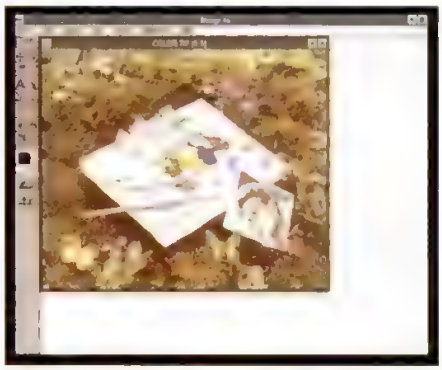
Mustang Software has released Version 3.0 of *Wildcat! BBS* ($129). The new version is a complete rewrite of the system and offers a host of new features including drastically increased screen rewrites, the ability to support up to 1,000 conferences, a full-screen text editor with full editing functions, echo functions to pass mail through other bulletin boards, and doors that terminate

Scanning Package Offers 24-bit Color Image Editing

IMPROVED **Image-In,** the American subsidiary of Geneva-based CPI SA, is shipping the 24-bit color version of its scanning and image-editing software, *Image-In-Color*. The package brings integrated scanning, editing, retouching, and color separation to *Microsoft Windows* 3.0.

Editing tools include airbrush, cloning stamp, smudge, image text annotation, composition, color correction, and color separation in RGB, HSV, and CMYK color models. The package supports color scanners from Epson, Nisca, Ricoh, and Sharp. Image-In plans to have drivers for the HP ColorScan IIc completed soon. The software is designed to support all popular scanners.

Image-In-Color will print to any *Windows*-supported printer in .BMP, EPS, .GIF, .PCX, .TGA, TIFF, and other graphics file formats.



Color is just the beginning for *Image-In*. The new version offers prepress color separation in CMYK, RGB, and CSV.

List Price: *Image-In-Color*, $795. **Requires:** *Microsoft Windows* 3.0 or later, Super VGA display or better. Image-In Inc., 406 E. 79 St., Minneapolis, MN 55420; 800-345-3540, 612-888-3633.

CIRCLE 439 ON READER SERVICE CARD

Updated Windows Comm Package Adds Zmodem, DDE, and MDI

IMPROVED **Software Ventures Corp.** has released Version 2.0 of *MicroPhone II*, its *Windows* communication package. The new version adds DDE links, Multiple Document Interface (MDI) support, and the Zmodem data-transfer protocol.

MDI allows *MicroPhone II* to have several concurrent sessions open. Each session can be iconized individually.

MicroPhone can act as both a DDE client and server, and its scripts can act as a communications link between *Windows* apps and external services. The program will accept scripts on the fly through DDE.

List Price: *MicroPhone II*, Version 2.0, $295. **Requires:** *Microsoft Windows* 3.0. Software Ventures Corp., 2907 Claremont Ave., Berkeley, CA 94705. 510-644-3232.

CIRCLE 438 ON READER SERVICE CARD

CAD Boards Boast Colors, Drivers, and Speed

NEW **Vermont Microsystems** has released a pair of VGA boards with drivers and applications that, according to the company, significantly boost the speed and quality of graphics under *Windows* and *AutoCAD*.

The Design Master VGA is a Tseng Laboratories ET-4000–based board, capable of 1,024-by-768 resolution with 256 colors. It sports a Sierra Hi-Color DAC (digital-to-analog converter) to display 32,768 colors at 800-by-600 and 640-by-480 resolutions. Standard boards ship with 1MB of RAM.

Bundled with the board is the company's *AutoMate/PRO* display list package, which includes an icon-based menu for *AutoCAD*, real-time anti-aliasing, pan/zoom and bird's eye views, and a magnifying glass. *VMI* 2x for *AutoShade* 2.0 and *3D Studio* doubles the resolution of rendered images while reducing rendering times by 75 percent. *True View*, a *Windows* application, displays true color images.

VMI is also offering the Cobra Elite Spectrum, an upgraded version of its Cobra Elite. The TI-34010 coprocessed board offers a top resolution of 1,024 by 768 with 256 colors. A perceived 16.7 million colors is possible with VMI's RenderReady graphics array chip. Modular upgrades offer memory expansion and VGA compatibility with a Headland-based VGA daughtercard. Upgrades from Cobra Elite to Cobra Elite Spectrum are available.

List Price: Design Master VGA, $495; Cobra Elite Spectrum, $1,795. **Requires:** Open ISA, EISA, or MCA slot. Vermont Microsystems, 11 Tigan St., P.O. Box 236, Winooski, VT 05404; 802-655-2860.

CIRCLE 440 ON READER SERVICE CARD

XTree Ships Antivirus App, Adds Viewers To XTree Gold

IMPROVED **XTree Co.** has begun shipping *ViruSafe*, an antiviral package consisting of six modules. The package is the fourth incarnation of EliaShim Microcomputer's product.

ViruSafe's modules include a 12K TSR that acts as a filter, searching through boot sectors, files, and memory for known viruses; Virus Check, which scans, detects, and neutralizes known and unknown viruses at boot-

CONTINUES ON PAGE 66

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BRIEFS

the BBS, pass information to another application, and allow you to rejoin the BBS when finished. *Wildcat! BBS* now supports CD-ROMs, network connections, and gateways. 805-395-0223.

Power BBS is now shipping *Power BBS* for *Windows* (shareware: $95; $180 professional version). The package offers both DOS and *Windows* doors, upload/download support for up to 50 simultaneous files, and, for an extra $30, automatic support through a door for all quickmail systems. A Turbo Pascal library is included with the *Power BBS* for quick creation of *Windows* add-ins. The system allows custom configuration of interrupt and base addresses, allowing you to bypass *Window's* communication drivers. Full demos of the system can be downloaded by modem at 516-822-7396. 516-938-0506.

MATH SOFTWARE

Racine Technologies has released *MP-Genesis* ($149.50), a 7K pop-up mathematical calculator. The program has 17 calculator functions and 30 subfunctions. It is user-configurable, allowing you to create "masks" customized to fit the particular formulas, conversions, and styles of your work. The basic package includes masks for finance, construction, and electronic industry formats. Masks that you create may be distributed without licensing from Racine. 800-676-3692, 619-445-3692.

Visual Solutions is now shipping *VisSim* ($895), a *Microsoft Windows*–based visual programming environment for mathematical modeling. The package provides over 60 prefabricated linear and nonlinear mathematical "blocks," which you combine and link with "wires" to create visual simulations. These simulations are plotted and then played back in real time or in successive steps. Visualizing complex situations and experiments and equations can be made easier by reducing and encapsulating complex routines into single, compound blocs. A software development kit, available for an additional $999, can be used to create custom blocks and functions in either C or Fortran. 508-392-2100.

CONTINUED FROM PAGE 64

up; Unvirus, which removes viruses that have already infiltrated a system; and a program integrity check, which performs reconstructions on diseased boot sectors and damaged partition tables.

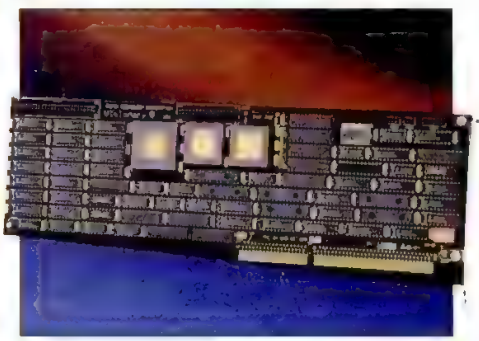
The company has also upgraded its popular file and disk management application, *XTree Gold*. Version 2.5 adds 13 graphics file viewers for 256 color images including .PCX, .BMP, EPS, TIFF, *MacPaint*, and .IMG formats. Also added are quick search options, on-the-fly self-extracting .ZIP file creation, a file-washing utility that destroys files to government specifications (including the Department of Defense's 5220.22-M standard), and the ability to use DOS commands in the AutoView mode.

List Price: *ViruSafe*, Version 4.5, $99; *XTreeGold*, Version 2.5, $149; upgrades from *XTreeGold* 2.0, $49.95 (includes *ViruSafe*). **Requires:** For *ViruSafe*, 256K RAM, DOS 3.0 or later; For *XTreeGold*, 256K RAM, DOS 3.1 or later. XTree Co., 4330 Sante Fe Rd., San Luis Obispo, CA 93401; 800-282-5003, 805-541-0604.

CIRCLE 441 ON READER SERVICE CARD

JPEG Compression Board Does 30-Frames-Per-Second Video

NEW Using the new LSI Logic chip set for JPEG video and still-frame compression, **Rapid Technology Corp.** claims to be able to achieve desktop video at 30 frames per second, the standard rate for digital video at CCIR-601 level resolutions (the display standard for video teleconferencing). The Visionary board has pin connectors for a video frame buffer that captures and passes digital video data in real time and a digital audio card.



The Visionary does real-time JPEG compression. It connects to a video frame buffer and sound board for real-time audiovisual presentations.

These products exceed the Multimedia PC standards, which show desktop video at 4 frames per second.

Passing the data through the frame buffer to the compression system allows the system to avoid the PC's bus, thus eliminating bottlenecks associated with PC video while simultaneously reducing storage overhead. The boards, combined with a fast, high-capacity drive, allow PCs to display real-time video without an analog device such as a laserdisk or a VCR.

List Price: Visionary, $1595; Visionary Video 601 Frame Grabber, $1295; Mono Digital Audio Card, $595. **Requires:** Open AT slots. Rapid Technology Corp., 4226 Ridge Lea Rd., #43, Amherst, NY 14226; 716-833-8533.

CIRCLE 442 ON READER SERVICE CARD

File-Transfer Package Claims Highest Throughput

NEW **Trans Digital Corp.** claims that its file-transfer system, Trans, can send files error-free at up to 10 megabits per second through parallel connections. Because the package takes advantage of processor speed, transfer rates depend on your CPU.

The Trans system, which consists of a proprietary parallel cable and Trans Digital's Write Back Engine software, transfers data on two 386/25s at rates 30 times as fast as 115.2 kilobits per second serial connections, according to the company.

The software, which allows transfers to be initiated from the DOS prompt, provides error-free connection over distances of up to 400 feet. The system can transmit unlimited files, but only supports file sizes of up to 2MB.

By using two additional copies of the package, Trans can connect up to four PCs, creating a low-cost, fast file-transfer network. It can also be used to drive printers and plotters.

List Price: Trans, $129. **Requires:** Parallel port, 64K RAM, DOS 2.1 or later. Trans Digital Corp., 37300 Central Ct., Newark, CA 94560; 510-745-9777.

CIRCLE 448 ON READER SERVICE CARD

Complete Upgradable 486SX/20 System Starts at $1,399

NEW **St. Croix Computers** has announced a low-cost upgradable 486 PC. The entry-level 486SX/20 retails for $1,399.

Basic configuration includes 2MB of RAM, a 52MB 17-ms. hard disk with a 64K cache, a monochrome TTL monitor, and MS-DOS 5.0 or DR DOS 5.0. The system will support a 486 with a clock speed of up to 40 MHz, and will handle up to 64MB of RAM and a 256K cache. Currently available processor upgrades are to 25- and 33-MHz 486DX CPUs. Upgrade prices were not available at the time this issue went to press. ■

List Price: $1,399. St. Croix Computers, P.O. 309, Lake Elmo, MN 55042. 800-279-0174, 612-430-3880.

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gration to both MS-Windows and non-Windows applications like Lotus 1-2-3, allows you to move to the next level up without sacrificing your previous software investments.

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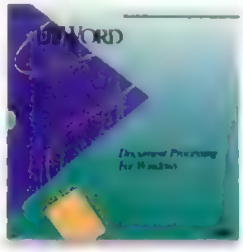

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edited by
Matthew J. Ross

Read Only

Reviews of the Latest Books for the PC User

The Paperless Trail: Minimizing the Risks Of Conducting Business Electronically

Information technology has given new meaning to the phrase "business as usual." Businesses now communicate orders directly from computer to computer, a practice known as electronic data interchange (EDI). In some companies, computers even monitor inventory levels and order replacements without human intervention.

One byproduct of such electronic business transactions is the disappearance of much of the paper trail that the American legal system relies upon to enforce obligations, resolve disputes, and collect revenues. Ultimately, business law will be modified to accommodate electronic innovation. Meanwhile, business users need to minimize their legal risks as they embrace these new commercial methods.

Benjamin Wright has been a pioneer in studying and advising businessmen and has been their counsel on how American law treats "paperless" (electronic) commerce. His pathbreaking 1989 volume *EDI and American Law: A Practical Guide* looked exclusively at EDI. In his latest book, *The Law of Electronic Commerce*, Wright expands his study to include the entire spectrum of electronic commerce—EDI, fax, e-mail, videotex, telex, and electronic funds transfer. Specifically, Wright addresses:

- The enforcement of obligations in a paperless transaction. For example, how are claims proved in court, and how do you satisfy the Statute of Frauds, which requires certain contracts to be "signed" and "in writing"?
- The liability of trading parties. How do businesses establish the "boilerplate" trading terms that used to be incorporated on the back of preprinted purchase order forms? How are risks allocated among traders and the owners of the communication networks when critical messages are garbled or lost?
- Record-keeping and auditing requirements. How do you satisfy governmental requirements and maintain internal controls in an environment where transmissions are either not recorded or are maintained in a medium that can be easily altered?
- Practical and constitutional privacy issues presented by these innovations.

The Law of Electronic Commerce is one of the first systematic studies of the law affecting a vital and growing area of commerce. But this is not just a reference book for lawyers. The book keeps its promise of being useful to both businessmen and lawyers. It is a sophisticated essay on urgent legal and business issues, informed by a solid awareness of business practicalities and enhanced by outstanding legal analysis.

Wright's syntax can be peculiar, and the $95 price tag for *The Law of Electronic Commerce* may seem prohibitive, but the book amply rewards the reader. It just may save you money in the long run.—*Kent H. Roberts*

The Law of Electronic Commerce
by Benjamin Wright
$95, Little, Brown and Co., 34 Beacon St., Boston, MA 02108; 800-331-1664. ISBN: 0-316-95632-5.
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SAMS 10 Minute Guides: A Kinder, Gentler Way to Learn and Use Software

Not everyone needs to become a software expert. If it's competency you need, the *SAMS 10 Minute Guide* series can get you there quickly and relatively painlessly. These reference guides tackle some of today's most popular software. They cost little, save time, and are small enough to keep in your briefcase.

The series includes topics such as *Lotus 1-2-3*, *Microsoft Excel*, DOS 5.0, *Windows* 3.0, and *WordPerfect* 5.1; each 150-page book costs $9.95. The books share a common format: The front inside covers have software installation instructions, the back inside covers list function-key assignments, and the middle of each book contains some twenty-odd tutorial exercises.

Each guide starts by defining its purpose, contents, and organization, and the best way to use the book. Each includes 22 to 26 tutorial chapters, typically 4 to 8 pages long. The chapters are designed to be completed in 10 minutes each, hence the series' name. Complex topics such as using spreadsheet stylesheets, coping with *Windows*' Control Panel, or managing disk directories are broken into logically divided subsections.

Each chapter includes readable sample screens, color highlights, and occasional reference tables. Icons identify time-saving tips, definitions, and common trouble spots. Each book ends with a DOS primer and a table of functions and features specific to the application.

The *10 Minute Guide to Excel 3 for Windows*, by Michael L. Miller (ISBN: 0-672-30222-5), includes lessons on basic spreadsheet functions and covers working with *Excel* databases. Because of *Excel*'s strength in this area, 8 of the book's 26 chapters cover spreadsheet appearance and stylesheets, with 3 other chapters devoted to charts.

The *10 Minute Guide to Lotus 1-2-3*, by Katherine Miller and Doug Sabotin (ISBN: 0-672-22809-2), covers Release 2.3 in 23 chapters. The authors don't cover *1-2-3* macros at all, beyond referring to the Macro Library Manager add-in program. It's also a bit surprising to see how little information is given on Release 2.3's WYSIWYG add-in, since this is such a major new feature in this version of *1-2-3*.

The *10 Minute Guide to MS-DOS 5*, by Jack Nimersheim (ISBN: 0-672-22807-6), is only an introduction to MS-DOS 5, but for users who spend most of their time in application software this guide serves its purpose well. Some lessons discuss the DOS shell; most of the 22 lessons focus on managing files and directories.

Katherine Murray and Doug Sabotin's *10 Minute Guide to Windows 3* (ISBN: 0-672-22812-2) has a formidable challenge, given *Windows*' many facets. The authors have only 22 chapters in which to provide information, but they do it admirably, including sections on using the print queue, *Windows* Write, Paint-

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March 26, 1991
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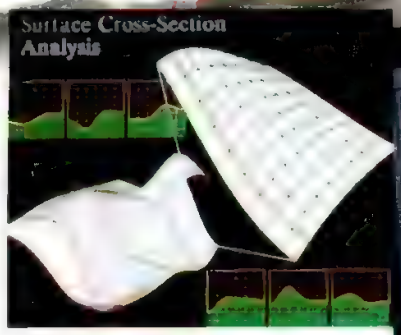

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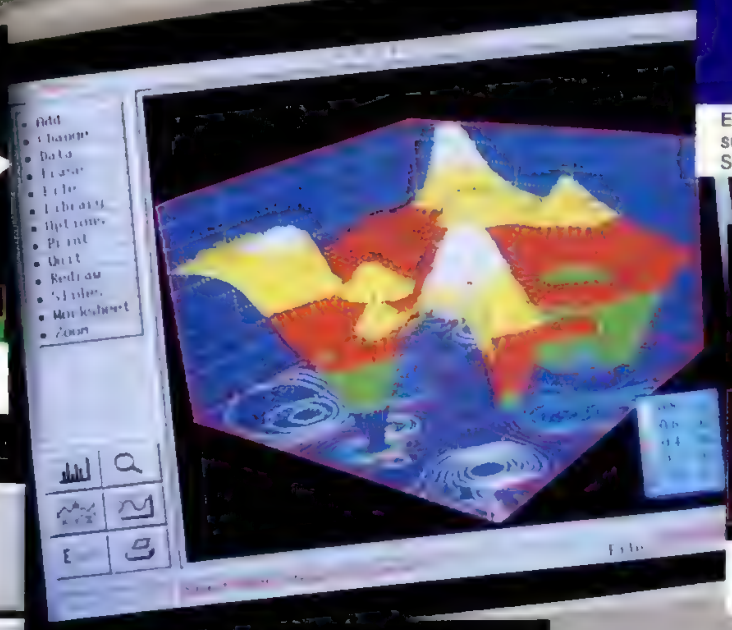

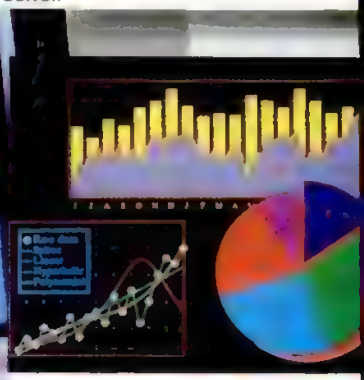

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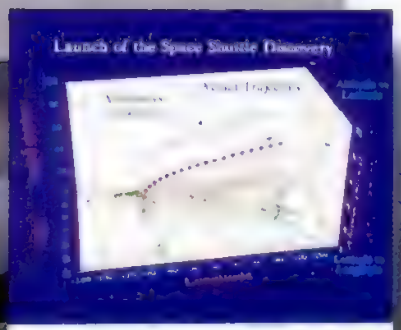

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brush, and the Desktop accessories. Murray and Sabotin also do a competent job in the *10 Minute Guide to WordPerfect 5.1* (ISBN: 0-672-22808-4), another 22-chapter guide that leads you from simple editing to working with fonts, aligning text, and adding headers and footers.

As a group, these books accomplish their goals and a bit more. Each is an adequate tutorial for both beginners and intermediate users. The *SAMS 10 Minute Guides* go beyond keyboard quick-reference templates and are a valuable first line of reference material.—*Bruce Brown*

SAMS 10 Minute Guides
$9.95 each, MacMillan Computer Publishing, 11711 N. College Ave., Carmel, IN 46032; 800-428-5331, 317-573-2500.
CIRCLE 418 ON READER SERVICE CARD

Microsoft Doesn't Reveal All in its New DOS 5 Programmer's Reference

Many people don't realize that DOS is really the world's most challenging adventure game. The goal of this adventure is to discover the hidden software hooks that Microsoft purposely leaves undocumented. The new *Microsoft MS-DOS Programmer's Reference* doesn't fully document DOS, but it is a welcome small step.

Roughly half of this 464-page DOS 5 reference is a list of the MS-DOS system calls, the so-called INT 21 functions. The other half discusses the file system, memory management facilities, character input and output system, and device drivers.

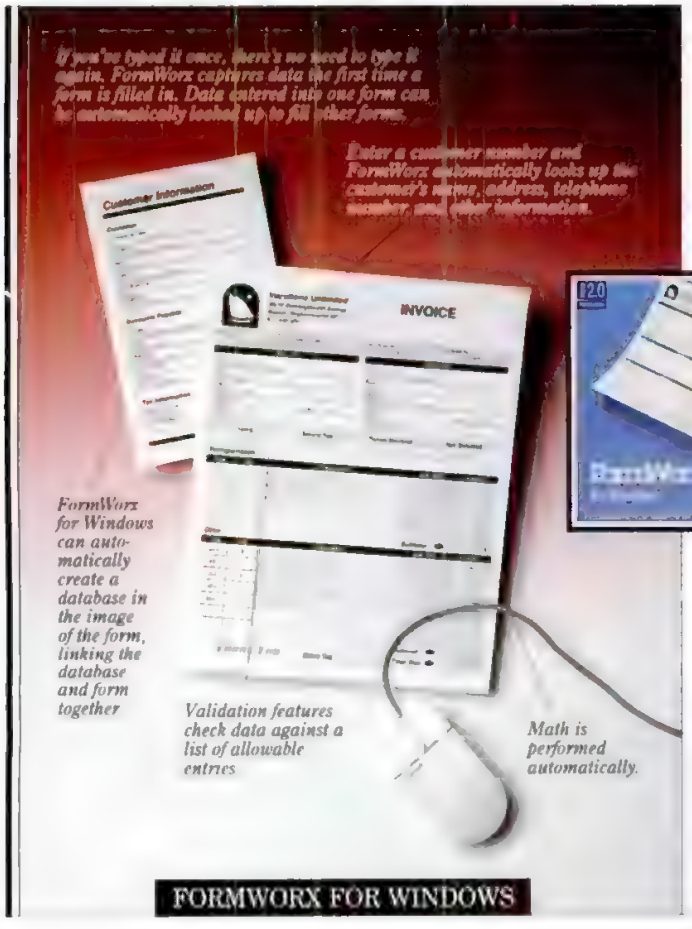
The book's best features are its coverage of the new DOS 5 task-switching interface and the greatly expanded coverage of the INT 2F multiplex interface, which is increasingly important to TSR programs. *Programmer's Reference* also details the structure of .EXE and .COM executable files, but it neglects to cover .OBJ object files or .LIB library files. Other omissions include any coverage of DPMI (the DOS protected mode interface), and the redirector, file sharing, EMS, ROM BIOS system call, and standard mouse interfaces. These topics are important to DOS programmers and are covered in most references.

The coverage of the INT 21 functions seems exhaustive at first, but careful examination reveals many holes. In comparison, Andrew Schulman's book *Undocumented DOS* (Addison-Wesley, 1990) covers 38 function calls that are undocumented in the Microsoft reference.

The coverage of the INT 2F multiplex interface fares similarly. Microsoft documents 33 multiplex functions, while Schulman details 172. The strong point of the *Microsoft MS-DOS Programmer's Reference* is its list of possible error return codes for each function.

If you're a DOS programmer, you need this book, if only for its information on the task-switching interface. But what we really need is a book from Microsoft that will tell us all about DOS.—*Kaare Christian* ■

Microsoft MS-DOS Programmer's Reference
by Microsoft Corp., $24.95, Microsoft Press, One Microsoft Way, Redmond, WA 98052; 1-800-677-7377. ISBN: 1-55615-329-5.
CIRCLE 419 ON READER SERVICE CARD



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edited by
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Toolkits

Reviews of the Latest Tools for the PC Programmer

C-scape 386 Boasts Flexible Data Entry Functions

Today's applications usually consist of core functionality surrounded by an event-driven, multiple-window, pull-down menu interface. In addition, an application that accepts input must be friendly yet have a robust data validation scheme. Providing all of this requires a large amount of user-interface code. Enter the C-scape 386 Interface Management System—a library of C functions that provides support for data entry, windowing, and menus.

C-scape 386 is a superset of the DOS version. It requires a DOS extender, which lets applications take full advantage of all installed memory, and includes libraries compiled for use with DOS extenders from Phar Lap Software, Ergo Computing, and Rational Systems. To use the Phar Lap and Ergo libraries, you'll need either the Watcom C386 compiler or MetaWare's High C Compiler. To use the Rational libraries, you'll need Microsoft C 5.1 or later, or Borland's Turbo C 2.0. For this review I tested C-scape 386 with Phar Lap's 386|DOS-Extender and Watcom's C386 compiler.

C-scape is particularly strong in its data entry abilities. Its data entry prowess begins with fields that are defined using a variation on C's `printf` statement. Fields can be used to enter almost any type of data, and can contain both writable and nonwritable positions. For example, a field specification for a phone number might contain (###) ###-####, where each # represents a writable position. When a field gets control, the cursor skips over nonwritable positions.

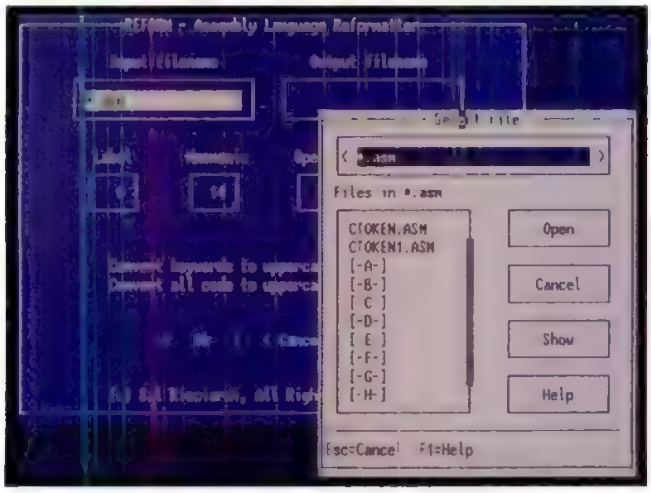
For each field, you provide C-scape 386 with the address of a field function structure. The structure consists of pointers to five functions that C-scape 386 will call to handle data entry and conversion. Each function has a specific call interface and responsibility.

The `senter` (screen enter) function converts a field's native data type to a string for display. Upon entering a screen, C-scape 386 calls each field's `senter` function before placing the cursor in the first field. Another function, `fenter` (field enter), is called upon entry into a field. It can perform field level "on-the-way-in" processing, such as changing the cursor size or displaying a prompt.

The `fkey` field function is called to accept user input, and is responsible for getting and acting upon keystrokes. For example, the `fkey` function can tell C-scape 386 to move to the next field when the Down Arrow key is pressed. When you attempt to leave a field, the `fexit` (field exit) function is called. It can perform field-level validation and will not allow a field to be exited if the validation fails. Finally, the `sexit` (screen exit) field function is used to convert all of the fields' strings back to their native types.

It is this field function mechanism that gives C-scape 386 a great deal of extensibility. Since each field has its function structure specified as part of its definition, you can customize field processing by writing custom functions, creating a custom function structure, and binding it to a field instead of using one of C-scape 386's built-in field functions.

For instance, to create a custom field that uses the gray Plus and Minus keys to do some special processing, simply create a custom `fkey` function and plug its address into a field's field function structure. C-scape 386 comes with a long list of built-in field functions, such as string_funcs for strings, date_funcs for entering dates, money_funcs for entering dollars and cents, and so on.



C-scape 386's flexibility lets you build custom functionality into your data entry screens.

Before you can use fields, you must create a MENU object. This is where C-scape 386's terminology becomes confusing. A MENU object is not a menu in the traditional sense, but rather an object (in the object-oriented sense) in which you lay out the structure of your screen. First you create a MENU, then you place text and define fields in the MENU using menu_printf, the variation of C's `printf` statement that I mentioned earlier.

Then, to make the screen come alive, you create a SED (screen editor) object based on the MENU. It employs a window through which a MENU's fields can be acted upon. The SED also handles all screen processing, monitoring movement between fields and managing the flow of control. You can have as many SEDs as memory will allow.

There's more to C-scape 386: Text editing functions, several menu systems, and a method of including context-sensitive help in your applications round out this product. But it also has its drawbacks—mainly a steep learning curve and, at times, downright confusing terminology. However, the basics are solid, and it's hard to imagine a more flexible approach to data entry. If you're willing to become religious in your efforts, C-scape 386 just might grant you a profitable priesthood.—*Sal Ricciardi*

C-scape 386 Interface Management System, Version 3.2

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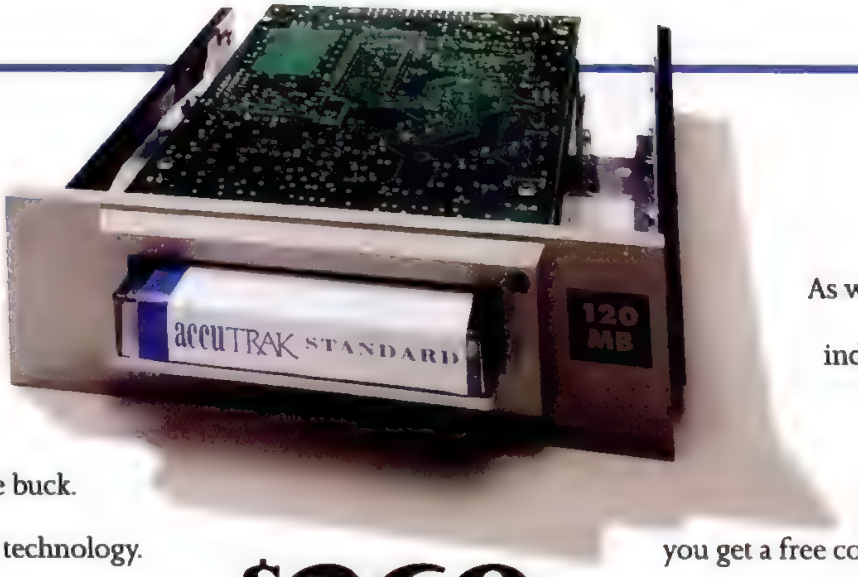

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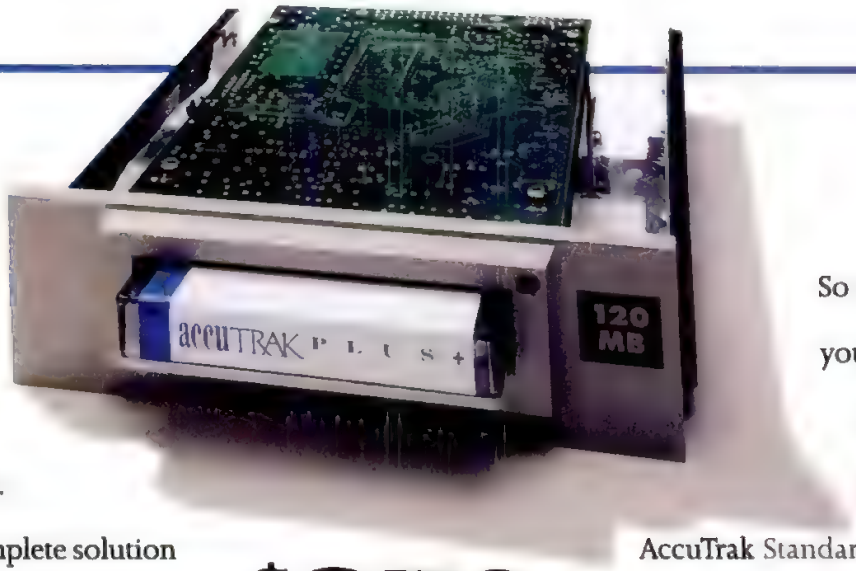

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Michael J. Miller

Sliding into The Future

The advances in *Lotus Freelance Graphics for Windows* give all of us the power to make smart presentations easily.

Once upon a time, graphics programs were designed to produce a single chart at a time. And that wasn't bad.

But a small Silicon Valley start-up had a great idea: Why not make a program that would let you create a whole series of slides at once, so you could store a large presentation as a single file. Anyone who makes presentations knows that you usually want to create many slides at the same time, and you want them to look like part of a consistent whole.

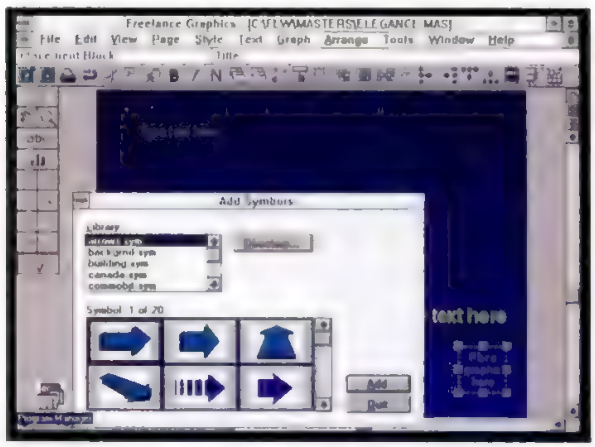
This package, called *PowerPoint* and originally written for the Macintosh, changed the way many of us use graphics programs. It defined a new category of product, called desktop presentation software. Since then, *PowerPoint* has been acquired by Microsoft and ported to *Windows*, and its presentation concept has become an integral part of most graphics packages. Indeed, almost all of the traditional packages, such as Lotus's *Freelance Graphics* and Software Publishing Corp.'s *Harvard Graphics* have added presentation features, and new programs such as Aldus's *Persuasion* and IBM's *Hollywood* have extended the desktop presentation metaphor in new ways. Now, a new *Windows* version of *Freelance Graphics* may again alter the way we look at presentation software.

PowerPoint remains the leading example of the basics of desktop presentation. You generally choose a single master, then create individual slides based on that master. You can pull in information from other software, such as *Microsoft Excel* charts or various drawing programs (*PowerPoint* was the first program released that supported object linking and embedding), or you can create graphics within *PowerPoint* with the included Microsoft *Graph* mini-application. The package has some of the best masters in the business and a great selection of clip art.

Among the ideas that *PowerPoint* pioneered was the Slide Sorter, a way of easily viewing and reordering the slides in your presentation on-screen at once, as thumbnail sketches. And, of course, *PowerPoint*'s spell-checker can check the spelling on all of your slides in a single pass. *PowerPoint*'s impact on the market has been profound, but other programs have advanced the state of the art, too.

Aldus's *Persuasion* (also ported to *Windows* from the Mac), introduced two significant advances in creating a presentation. The first was its outliner for creating a series of text charts. It lets you put down your ideas, easily reorganize them, and even collapse and expand the level of detail you see. *Persuasion* then takes your outline and automatically creates a series of text slides based on it. Any changes on your slides are reflected back in the outline, and you can sort your slides both in a slide view and in the outline.

Persuasion's other major contribution was its AutoTemplates, a series of masters designed for different kinds of charts such as title pages, text charts, and charts with graphics. Choosing a specific template causes the size and placement of different elements to change accordingly. *Persuasion* also lets you preview your templates so you know which one you are choosing, and it's easy to append multiple templates together.



***Freelance Graphics for Windows* offers many ease-of-use features, such as these thumbnail sketches from your symbol library and prompts in its master slides.**

Persuasion does have several areas that could be improved. It's too slow, seems a bit complicated, and has a terrible installation program. Still, it is probably the most powerful

presentation package on the market.

IBM's *Hollywood* is a somewhat simpler program that follows in *Persuasion*'s footsteps. Like *Persuasion*, it has an outliner and creates graphics, but *Hollywood* stores its outline and graphics in separate files that are linked directly with your presentation. Another interesting difference: Text in *Hollywood*'s outliner is displayed with the same attributes that it will have in the slides, a useful feature. For on-screen slide shows, *Hollywood* offers another useful feature called *progressive build* to show various layers being added to a slide, providing a sort of simplified method of animation.

On the downside, I found *Hollywood*'s data-chart features confusing. Where the other programs make it easy to change a bar chart into an area chart, this is very difficult in *Hollywood*. And unlike the other programs in this group, *Hollywood* lacks a slide sorter, a significant limitation. In short, *Hollywood* is a good first effort, but it doesn't really break much new ground.

BUILDING ON A SOLID FOUNDATION

The newest program in the category, *Lotus Freelance Graphics for Windows*, takes many of the other programs' concepts (the outliner, multiple masters in a single template, and a slide sorter) and builds on them to great effect.

What sets *Freelance* apart is its SmartMaster feature, which was pioneered in the OS/2 version but substantially improved for the *Windows* version. With SmartMaster, you typically start your presentation by bringing up a template and choosing the master you want for each slide, such as a master that includes both bullet points and symbols. When you bring up the master, it has points that indicate helpful prompts, such as "type title here." All you have to do is click on the appropriate point and start typing. You can even click on an "insert symbol" space and the program shows you your symbol library, previewing exactly how your drawings on-disk look. That's a wonderful time-saving feature I really miss in the other programs.

Like Lotus's *Ami Pro* 2.0 and *1-2-3 for Windows*, *Freelance* has a customizable icon bar, in addition to the toolbar that is common to drawing programs. *Freelance*'s outliner is visually quite striking; it looks like a yellow ruled notepad, the kind you might well use at your office or school. However, its outline features are considerably weaker than those in *Persuasion* or *Hollywood*.

All in all, *Freelance* is particularly impressive because it is so easy to use. For anyone who thinks in terms of slides and the elements on them, *Freelance* makes creating a presentation a snap. It 's taken the whole category a step forward in ease of use—something we need more of.

I produce more text charts than anything else, and I like to use an outliner to work with my ideas before even looking at slides. For that, I still haven't seen anything better than *Persuasion*, warts and all. But for creating a presentation when you know what you want to say, *Freelance* is much easier. I just might be ready to change packages again. ■

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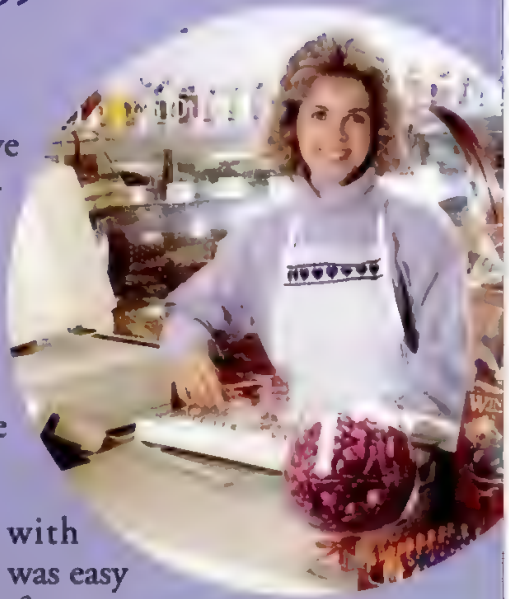

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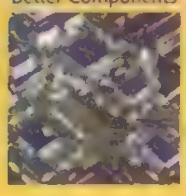

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Bill Machrone

Are NT Promises MT Promises?

Microsoft is promising an incredible amount with NT, its "New Technology." Could the company be unintentionally overselling?

My uncle Dominick has always been a kidder. He got me to eat liverwurst when I was a tyke by telling me it was "cowboy" liverwurst. He used to ask me if it was "hotter in the city or in the summer or in the cellar." He used to tell me to point to my head and say the abbreviation for mountain. I loved his tall tales and improbable yarns.

If I didn't know that Uncle Dom was quietly retired at the Jersey shore, I'd suspect that he'd taken a job with the biggest employer in Redmond, Washington. Maybe it's that clean Northwestern living, or the rain or something, but it seems that the deeds are a little bolder, the missions a little braver, and the operating systems a little more powerful than reason would dictate. I'm not accusing Microsoft of exaggerating, at least not on purpose. But we should examine the enormous task the company has set out for itself and try to get a better understanding of whom it's for, why we should care, and why we should be cautious.

There's no point in dredging up all that stuff about how OS/2 was going to be the dominant operating system by 1989. Instead, let's get to the good stuff: New Technology, or NT for short. (It was briefly called OS/2 3.0, if you're having trouble keeping track of all this.) NT is nothing less than the modern reinvention of the operating system, conceived in terms of the microprocessor and today's realities of function and connectivity.

The NT effort is headed by Dave Cutler, the father of VMS, Digital Equipment Corp.'s operating system for its VAX minicomputers. In some respects, VMS is arguably the most sophisticated operating system out there today, especially in distributed information and large networks of machines. For wide-area connectivity, the only operating system you can even mention in the same breath is Banyan's *VINES*. One of *VINES*' key developers, Jim Allchin, now works for Microsoft, too.

These folks are hard at work on the operating system to end all operating systems. When they announced it this past January, it was a veritable Swiss Army knife of features, with a promiscuous list of application program interfaces (APIs): 16-bit *Windows*, OS/2 Presentation Manager, POSIX, 32-bit *Windows*, and DOS. Plus a few more unannounced APIs. Today, they're not so sure that PM will be on the list of supported APIs. What a surprise.

WHY IS THIS TIME DIFFERENT?

One of the biggest battles in Microsoft's original work on OS/2 was over the graphics engine. IBM insisted on GPI (Graphic Program Interface), derived from GDDM, its mainframe graphics API, while Microsoft campaigned for continuance of *Windows*' GDI interface. Even after losing that struggle, Microsoft continued to tell developers, "Write for *Windows* and we'll get you to OS/2." It never happened, although Micrografx's Mirrors technology came pretty close.

The current story is that all the old applications will run under *Windows-32*, the next major release of Microsoft's graphical environment. It'll have lots of OS/2-like features, such as preemptive multitasking, multithreading, flat addressing, and a 2-gigabyte work-

ILLUSTRATION: SHANNON JEFFRIES

space for applications—but with a *Windows* graphics API. It sounds suspiciously like Microsoft's initial conception of OS/2.

Where does this leave NT? Not on the desktop, that's for sure. First of all, you'll need 8MB just to light it off. Not that 8MB will seem like much memory by the time NT ships, but it's a significant barrier to the installed base. Second, much of the new stuff in NT is oriented toward secure networks, connectivity, distributed file systems, and portability. NT is

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CIRCLE 727 ON READER SERVICE CARD

Bill Machrone

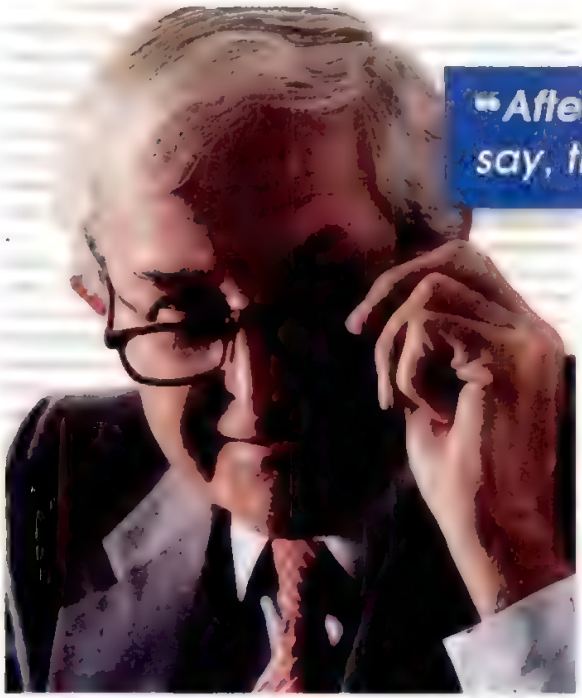
Microsoft's gigantic hedge against a world not dominated by Intel and its 80x86 architecture. It's one of the two operating systems intended for use on the MIPS-powered ACE machines, the other being Unix. And ACE, depending on whom you ask, is either a hot workstation architecture or minicomputer replacement architecture. Neither will replace PCs on most desktops.

As for backwards compatibility with existing applications, forget it. Every major operating system vendor, upon unveiling a new OS, has announced backwards compatibility. None have ever delivered what they promised, and I see no reason for this time to be different. IBM was well-intentioned back in the mid-sixties when it announced Autocoder support for OS/360, but that operating system was more than a year late and ran like a pig. Data General built backwards compatibility into the Eclipse, as chronicled in Tracy Kidder's book *The Soul of a New Machine*, thereby winning the battle and losing the war. If there weren't so many flavors of Unix, it probably would have taken over the world by now.

Microsoft is certainly intent on its backwards-compatibility purpose, too. But history shows that multiple-platform support is the enemy of backwards compatibility. And NT is intended to run on at least four platforms. So I think we can safely dismiss the hyperbole: Backwards compatibility is the first thing to go in the hectic final phases of development. Let's hope Microsoft forgets this quixotic mission and concentrates on just a few robust APIs that will take us forward.

Let's not get too confused about NT and the desktop either. The future of the desktop is *Windows*, not NT. Microsoft has said that DOS will continue into the foreseeable future. Unfortunately, the foreseeable future in this business is about six months, give or take a strategic relationship or two. Now that Digital Research has Novell behind it, Microsoft will probably move users away from DOS as quickly as possible, touting *Windows* as the multitasker that runs DOS, with multiple sessions if you like. Users will be able to take or leave the *Windows* GUI.

If all this doesn't work out, Microsoft can hire Uncle Dom to handle the resulting PR campaign: "Only kidding." ■



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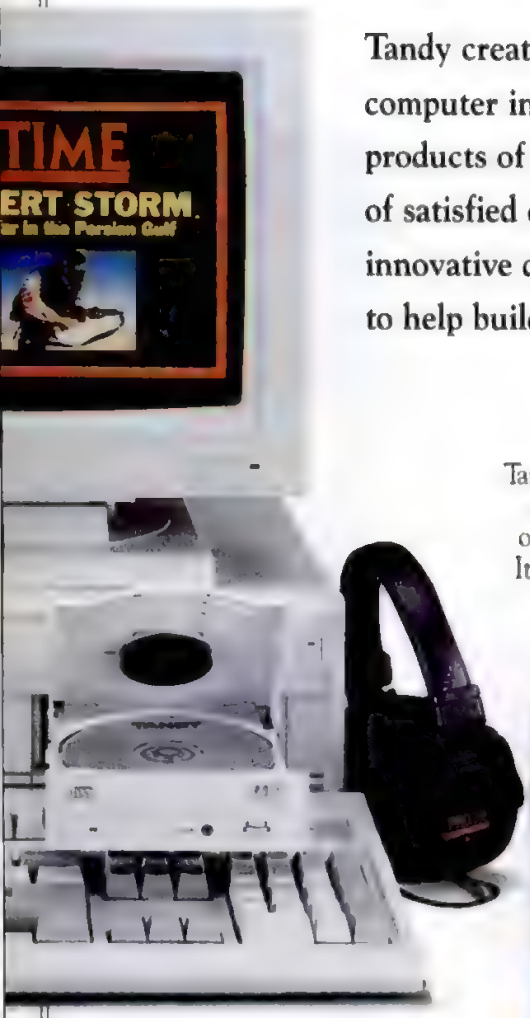

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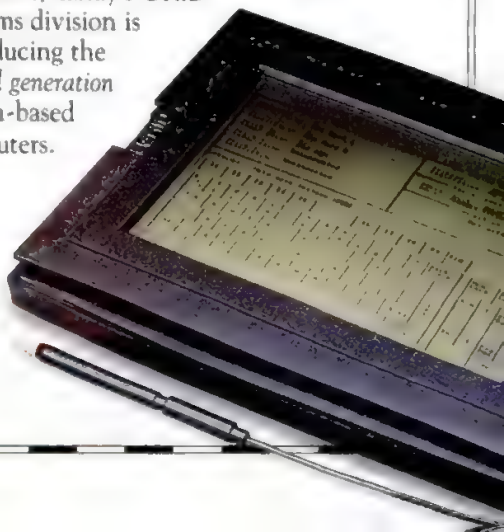

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John C. Dvorak

A Crock Is a Crock

Idealistic rhetoric and misdirected government influence over technology will only hurt progress in the long run.

Most of us have given up on the wacky idealism that said computers were going to revolutionize the world. This malarkey died around 1985 after a decade-long run. The latest "new" technology to have a revolutionary effect on anything was the archaic fax technology during the Tiananmen Square episode in China. Even so, the system there hasn't changed and there are a lot of dead revolutionaries.

So just as I thought the rhetoric was dead, here comes *Scientific American* bringing it all back in a special September issue called "Communications, Computers, and Networks." The articles spew daft New Age nonsense that harkens back to the earliest days of personal computing. Cornball stuff. Look at a few of the summary headlines from three of the articles. Do these words sound like something from a decade back?

- "By fusing computing and communications technologies, we can create an infrastructure that will profoundly reshape our economy and society."
- "Computer networks are forging new kinds of markets and new ways to manage organizations. The result will be a major change in corporate structure and management style."
- "Tired of the restraints of space and time? Intelligently designed network products that understand the needs of the individuals will set us free."

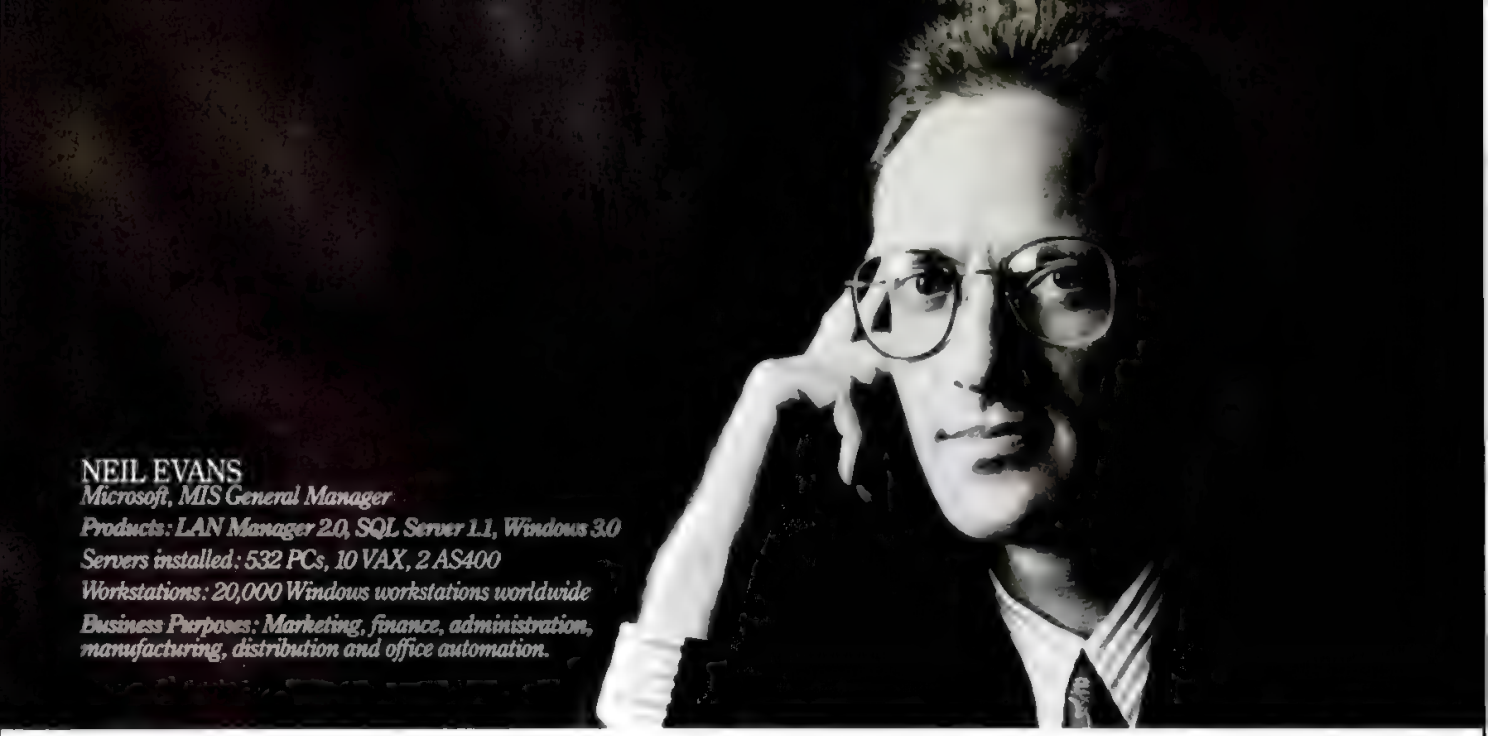
Is this a crock, or what? It gets worse when you read some of the articles, which range from a carefully orchestrated self-promotion of MIT's Media Lab (so what else is new?) to Alan Kay's confusing diatribe about what's wrong with education. In all cases, computers will save us from a terrible fate. Even the dopey and idealistic concept of the "Knowbot" is seriously discussed. The Knowbot is a worm-like program that will supposedly go out onto the networks on your behalf, explore databases, and bring back the information you desire. Can you imagine the kind of bill that would rack up on *Dialog*, for example, if such a capability existed? Get real, guys.

When I see these kinds of special issues from influential journals such as *Scientific American*, I always suspect a hidden agenda. And there it was: Senator Albert Gore's article entitled "Infrastructure for the Global Village." Yikes! Shades of McLuhan! Gore pushes his agenda for a modern equivalent of the intercontinental railroad: a giganto data network. Gore writes that we should spend a ton of the taxpayers' money for a gigantic data highway because, uh, it's a good idea. Among other benefits, it would "bring the book to the child at home, pictures and all." Golly gee whiz! By the way, Senator, most of today's New York publishers still do everything on typewriters! What magic will turn these books into data? Hand scanners?

Meanwhile, I note that nowhere in the article does Gore even once mention ISDN. I could only find one passing mention of ISDN in one of the 11 special articles. Here's a technology that should be implemented as a national policy: the government should mandate that the phone companies go digital. There's your boost for the communications infrastructure.

Gore's data highway appears to be a big boondoggle and a potential multibillion-dollar fiasco. Let's minimize government's involvement in technology. I've yet to be convinced that even Gore, who is considered one of the high-tech senators, knows anything at all about computers. Most of our representatives are pathetic technophobes. These guys stalled digital audio tape and are keeping digital TV and digital radio from implementation. Their collective ignorance will do more harm than good. *Scientific American* should keep such blatant opinion pieces out of the magazine. When presented among feature articles (as this one was), they represent nothing less than sickening propaganda.

ILLUSTRATION: SHANNON JEFFRIES



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John C.
Dvorak

Inside Track

The question that comes to mind: Why didn't **IBM buy Digital Research Inc.** instead of allowing it to become part of Novell? With DR DOS 6.0 looking like **the best** of all worlds and with a staff who'd love to work on OS/2, the company seems like the perfect match for IBM. So what happened?

I suspect that when the Novell deal was announced, IBM execs **slapped themselves** on the foreheads saying, "Why didn't I think of that?!" Professional observers believe that IBM thinks it has **plenty of good people** working on OS/2 and that it isn't interested in continuing with DOS anyway. Maybe all the white collars at IBM couldn't get their rumps in gear.

A rumored twist on the DRI/Novell deal is that it's part of a strategy implemented by none other than Lotus. One **gossip** says the old Novell/Lotus deal never really fell through. Here's how it goes: Lotus had its eye on DRI to compete with **archenemy** Microsoft, but a giant Novell/Lotus corporation would have had to cough up much more dough for DRI than a smaller Novell would be asked to pay.

Guess again. Truth is that **shenanigans** on the Novell board are what really queered the Lotus deal, and such a scheme concerning Digital Research is **too convoluted** to work. Still, imagine a company made up of Lotus, Novell/DRI, Borland and Symantec. Then again, you might have too many big egos to fit in one room!

> I bet that IBM execs slapped themselves on their foreheads when the Novell/Digital Research deal was announced.

Read This Item and Buy a 486 Dept.: One of the **most interesting** newsletters nowadays is *Text Technology*, published bimonthly by Wright State University—Lake Campus ($20 a year; *Text Technology*, Wright State University, Lake Campus, 7600 State Route 703, Celina, OH 45822; 419-586-2365, ext. 256.). *Text Technology* specializes in information about text processing on computers. In its July 1991 issue (No. 4), the newsletter ran a unique comparison of relative CPU speeds. A number of processors were compared in various situations. The article was clear in its recommendation of a 486 computer, saying that the 486 was **faster than you'd imagine** for text processing and that it's the clear choice for writers. A 25-MHz 486 was typically 500-percent faster than a 20-MHz 386. For the few of you who think an 8088 is acceptable for "mere word processing," look at the table of scores adapted from information given in the newsletter. Get July's issue of *Text Technology* for the detailed methodology.

Eric Johnson, a professor at Dakota State, is well known in the computing community, and he authored this interesting study. Johnson's conclusion is that a 486 is the computer of choice for people working with text, especially if their work involves doing large-scale analysis and manipulation of large pieces of text. This effectively shuts up the complainers who say that fast machines are wasted on text.

Genuinely Interesting Software Dept.: Here's a product that epitomizes creativity. It's called *DeltaFile*, and it's from hyperkinetix inc. (615 N. Poplar St., Orange, CA 92667; 714-935-0823). It's the **perfect program** for developers. *DeltaFile* takes an original program and its updated code and does a bit-by-bit comparison of the two. It then compiles **a third program,** which is in the form of an executable file. When run, this executable program makes any necessary changes to the original software, thus creating the updated code on the fly. 700K programs can sometimes be updated with a small 20K program, **eliminating multiple disk upgrades** and making it **easy to download an update,** too. Though not for everyone at $249, if you need it, it's **a steal.**

More Genuinely Interesting Software Dept.: Two coders developed a couple of programs proven **to do the impossible:** to make a PC keep accurate time. One is *RighTime*, which corrects the flaw in the computer clock to keep it accurate for weeks. The other is *TimeSet*, a program that dials in to the **cesium-beam atomic clock** of the U.S. Naval Observatory to set the computer clock within 5 **milliseconds of perfection.** *TimeSet* can be ordered for $35 from author Pete Petrakis at Life Science Software, P.O. Box 1560, Stanwood, WA 98292; 206-387-9788. *RighTime* is available for $25 from its author, Tom Becker, at Air System Technologies (14232 Marsh Lane, #339, Dallas, TX 75234; 214-402-9660). *RighTime* will work with *TimeSet* and the cesium-beam atomic clock to create the necessary algorithms to ensure accurate correct-time adjustments. I find it **annoying** that the clocks on these desktop PCs are so inaccurate. It doesn't endear their math to you, does it? ■

RELATIVE CPU SPEEDS

Program	25-MHz 486 (seconds)	4.77-MHz 8088 (seconds)	Factor (difference in speed)
Math 1	1.0	41.4	41.4
Math 2	4.8	209.9	43.7
Text 1	0.8	33.6	42.0
Text 2	0.5	34.2	68.4
Text 3	2.9	209.4	72.2
Logic	1.4	147.0	105.0

Adapted from *Text Technology*, July 1991.

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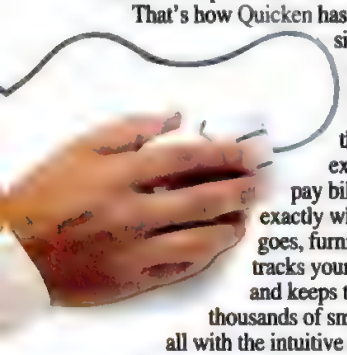
Each year we survey 10,000 users to learn how they'd change Quicken. These surveys led to Quicken 5.0's advances in report flexibility and automatic budgeting.

With Quicken, you have the culmination of years of refinements...and a future of relentless improvements.

That's how Quicken has grown – from a simple checkbook manager into a powerful financial tool that categorizes expenses as you pay bills, reports exactly where your money goes, furnishes tax reports, tracks your investments, and keeps the books for thousands of small businesses – all with the intuitive simplicity and speed of the original.



Mouse support was the top request in Customer Suggestion cards. It's in both new versions.

Name just about anything you like about Quicken, and we'll tell you how it's more powerful, more flexible, faster, and even easier now.

New reports and flexible reporting features. Now you can collapse or expand reports "outline-style" to see as much or as little detail as you want.

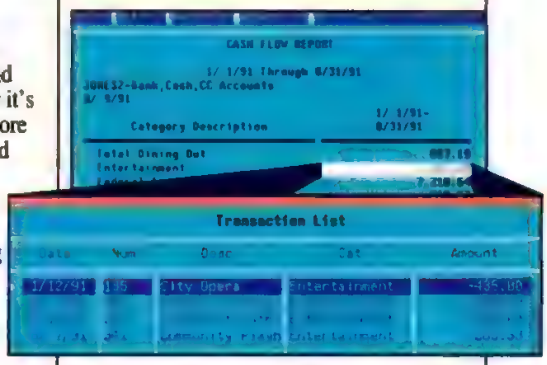
A keystroke or a mouse click lets you "zoom in" on a number to see the details behind it, then zoom in even closer — to the transactions behind the detail.

You can even reformat a report while you look at it. So, for example, to see transactions by payee instead of by date, you just choose among formats on the new pull-down menus. No need to leave the report — the transactions instantly re-sort.

New reports show interest and principal for each house loan... reveal missing checks at a glance ... provide tax schedules ready to submit with your returns, and more.

New budgeting power. We've made the hardest part — creating a budget — simple and fast. You can copy one month's budget to all other months or let Quicken automatically create a budget for you based on your actual spending, and tweak it from there.

We've made budgeting more precise, too, with subcategories. Under "Automobile" for example, you can allocate separate amounts for gas and maintenance. You can also budget a yearly amount for a category and let Quicken allocate it quarterly or monthly.



Ever question a number in a report? One keystroke, and a new QuickZoom screen pops up with the supporting details. Need more detail? Tap that key again to zoom in on any transaction.

New tax information. New Loan Amortization calculates the interest and principal automatically each time you make a house payment and correctly categorizes each. And now Quicken automatically transfers data to the right lines in the right schedules of leading tax programs.

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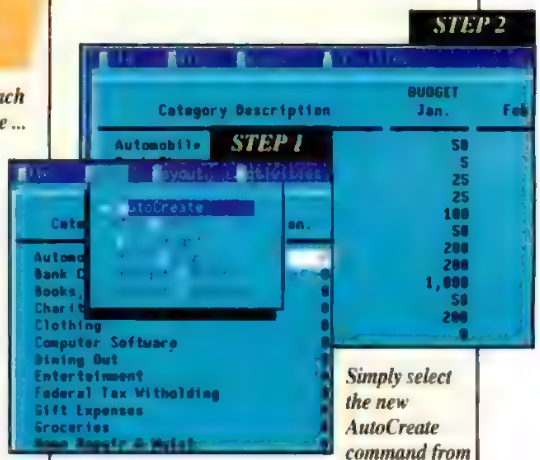

Simply select the new AutoCreate command from the new pull-down menu and Quicken automatically fills in your budget based on last year's spending. Now play "what-if" until you see the results you want, and you've got a detailed plan to meet your financial goals.

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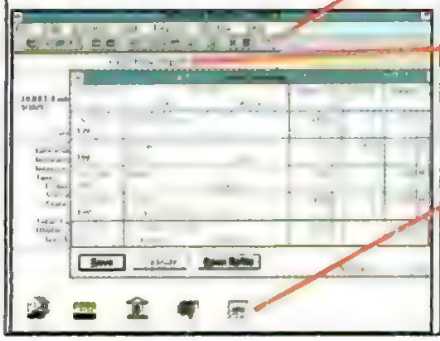
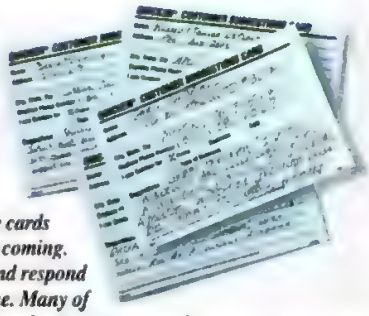


Only Quicken lets you see multiple account and report windows on screen at once, so you can investigate the detail behind numbers and easily plan and forecast.

Create your own Quicken desktop, and keep your most frequently used accounts, lists and reports where you can always find them fast.



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Jim Seymour

Plug-In PCs

Upgradable computers make sense these days, but don't take your wallet out just yet.

Personal computers are in general pretty modular devices. From the first IBM PC ten years ago, we've been able to swap, exchange, and upgrade with relative ease the hard disks, floppy disk drives, monitors, video adapters, and other boards inside the box.

This inherent modularity has made the sudden rise and popularity of "modular" and "upgradable" PCs over the past few months a bit odd. Odd, that is, until you consider why manufacturers have turned to them. And odd, until you consider how well they seem to meet some buyers' needs.

Of course, "relative ease" is—well, highly relative. For the PC maven, popping the top on a PC, swapping an old 20MB drive for a new 100MB one, adding a couple of megs of memory, then buttoning the system up is a 10-minute job, during which he can also tell three juicy Bill Gates stories and advise a passerby on using SysEdit to change his WIN.INI file.

But for the typical office worker, "going under the hood of a PC" can be a daunting experience. Far more of us are near the techno-klutz end of the spectrum than the techno-wizard end.

So although PCs have always been highly modular and highly upgradable, these new machines offer a variety of tricks to make those upgrades easier.

Now it's caveat emptor time, in spades, because it's easy to get burned with modular PCs. You just might buy the wrong machine at the wrong price—one you'll *never* upgrade.

Two issues ago, *PC Magazine* reviewed ten modular PCs generally representative of the breed (October 29, 1991). That same issue also ran a First Looks piece on Compaq's new Deskpro/M line of modular PCs. I want to add some comments on these machines, based on my work with several big clients who were looking at standardizing on modular PCs.

I think that in general, modular PCs are a good idea—if you don't pay a price premium to buy one. That's pretty obvious; they give you more flexibility than nonmodular machines, and any time you can gain flexibility for free, you're better off.

The trick is to avoid buying a machine today that will trap you tomorrow. Because no matter how you upgrade that machine, you'll always be trapped within the basic technical standards it represents. Sure, you can upgrade this and that, but all those new parts you drop in still have to live with some older ones: the machine's bus, for example.

We're in a period of relative calm now on the evolution of technical standards. Sure, there's a bewildering (and arguably foolish) array of new 486 chips available. Sure, video standards are in flux. And sure, every month we see increases in mass storage options. But in general, we know where we're headed.

We'll see a new 64-bit bus standard, for example, in a few years, but for now the 16-bit (AT-class) and 32-bit (MCA and EISA) buses hold sway. They are likely to dominate the Intel-based PC marketplace for some time. But it's still easy to buy the wrong standard.

Tip 1: Don't consider a modular PC with an AT bus. Buying a modular machine is itself a bet on the future, and we know that the AT bus is not going to be an important part of that future. That means buying EISA machines, since no truly modular MCA machines are available. Yet there are few EISA-based modular PCs.

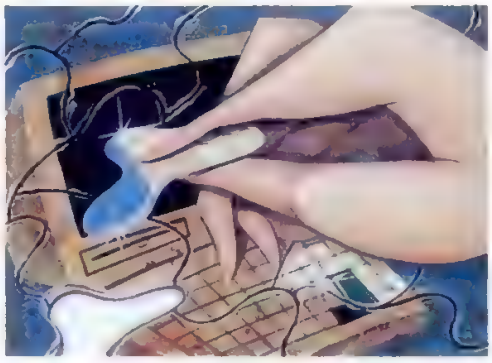

ILLUSTRATION SHANNON JEFFRIES

Memory is an issue, too. Each new generation of microprocessors ratchets up the computer's overall clock speed. Memory chips must then be faster to keep up with the CPU. We've seen random access memory spiral down from the relatively slow 150-nanosecond range to 70 or 80 ns. (and even lower) as CPU clock speeds have increased from 4.77

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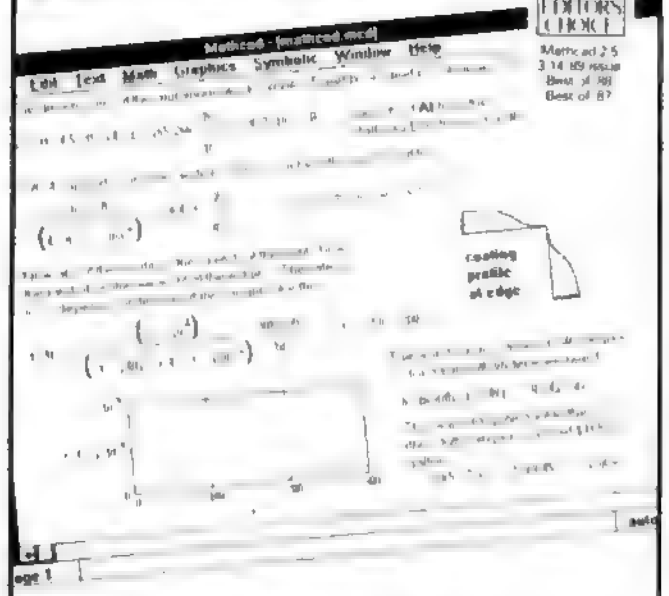

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Jim Seymour

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Yet with some modular PCs, your hot new CPU upgrade will be forced to work with older, slower memory—so you won't get all you're paying for. **Tip 2: Don't buy a modular PC that doesn't allow for easy, one-step memory swapping when the CPU is upgraded.**

Some sellers of modular PCs are blanketing the market with every possible increment of CPU upgrade. Northgate, for example, offers 25-, 33-, and 40-MHz 386DX, 20-MHz 486SX, and 33-MHz 486DX modules. That's good for Northgate (keep reading) but may not be very useful for buyers. You don't want to upgrade one piddly step at a time; you want a big jump in power, or the upgrade is not worth the cost.

Tip 3: Don't be impressed by a plethora of upgrade choices. Look for big leaps in power; you won't care about buying small improvements.

I said that a wide variety of upgrade increments worked well for vendors but not necessarily for buyers. Here's why: Modular PCs came into existence because they help vendors with design, manufacturing, and inventory problems. Now they can make one motherboard, and then plug together from standard parts the configuration you want at the time of the sale. In the past, new CPU chips, even higher-speed revs of existing chips, meant time-consuming and expensive redesigns. It also took time to produce the circuit boards for these new designs. And carrying a line consisting of many models, each with a different CPU and CPU clock, meant a much more complicated manufacturing process overall.

Designing PCs for specific chip revisions also meant vendors had to make some risky guesses. If you thought you'd sell 5,000 PCs next month, you had to guess how that would break down among, say, 16-MHz and 20-MHz 386SXs; 20-, 25-, 33-, and maybe 40-MHz 386DXs; 25- and 33-MHz 486s; and maybe 20-MHz 486SXs, too. And that's just desktop models. Then you'd build that mix of machines. If subsequent orders didn't match that "build," then you carried some *very* expensive inventory.

Modular PCs, on the other hand, dramatically reduce design time, production start-up times, and inventory costs—while making it possible to offer a wide variety of models. That's why we see this apparently silly range of "upgrade" options: for the vendors' convenience in building the first machine we buy.

Let's move on to the economics of modular PCs. Look at the cost of upgrading one of these new machines and it might be almost as much as the price for a whole new PC built around the chip you're upgrading to. But it gets worse: You're not going to upgrade tomorrow, or next week, but in a year or two. With the steady fall in prices of PCs, might not that upgrade actually cost *more* than a similar but entirely new PC by the time you get around to moving up?

Probably not. The same forces driving down the prices of new PCs will drive down the prices of upgrade modules as well. Still, the prices may not be that far apart. Which means that buying a whole new faster PC may not be a bad idea: You can sell the older one or pass it on to a co-worker who needs a better PC.

But you won't know that until you're ready to make the upgrade decision. Which leads to **Tip 4: Don't pay a premium for a modular PC over an equivalent nonmodular machine.** That way you'll be in good shape whether you upgrade or not.

And **Tip 5: Look for sellers of modular PCs who will guarantee that the upgrade cost will never be more than the price delta between the model you have and the model you want in their lines.** This still doesn't mean that you won't buy a second machine, but it does put a price floor under your decision.

Readers want columnists to be prescriptive, not merely analytical: "So tell me what you *really* think! What should I do?" Okay. In my work, I found one modular PC I could recommend unreservedly to clients. It's Amkly's new all-EISA design, which swaps memory on the same upgrade board as the CPU chip, and which upgrades pricing based on the price difference between the model you have and the model you want.

Unfortunately, though Amkly Systems got everything else right (perhaps *because* it did), the Amkly machines are relatively pricey: at list, for any given CPU, about $1,000 more than comparable nonmodular PCs from other vendors.

Sigh. Whether it's a modular, upgradable, or traditional PC, we still get what we pay for. ■

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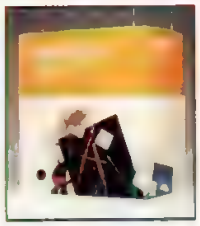

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Electronic security	no	yes
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Support for printer macros and cartridges	no	yes
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CIRCLE 250 ON READER SERVICE CARD

William F.
Zachmann

Object-Oriented Is Not the Only Way

Development tools that fail strict OOP definitions can still be useful.

One hot software category that will have a big impact on computing in the next few years is the so-called *higher-level development tool*. Running on microprocessor-based systems and often supporting graphical user interfaces (GUIs), these tools are giving developers more-powerful means to build enterprise-wide, mission-critical software systems.

The "'higher level" label means the ability to create applications with software that is more sophisticated, more powerful, and easier to use than traditional procedural programming languages such as COBOL, FORTRAN, PL/1, C, or Pascal. This broad category includes programming languages like C++, Smalltalk, or Microsoft Visual Basic; development systems like Whitewater Group's *Actor* or Gupta's SQL Windows; development environments like Within Technologies' Realizer; and others.

Not long ago, the biggest problem with such tools was that they simply weren't very good. They were too complicated, too limited, or performed too poorly to be practical. Now, a growing number of them do deliver on the promise of easier development.

Object-oriented programming (OOP) languages, databases, and development systems are a very important part of the current array of available tools. OOP will certainly have a major role in bringing the inexpensive power of microsystems to "industrial strength" applications.

The catechism of object oriented is that *encapsulation, polymorphism,* and *inheritance* are the criteria of a "'true" object-oriented programming system.

Encapsulation means that classes of objects (and therefore, of course, the objects themselves) are defined not only in terms of what they are, but also in terms of what they are able to do. Polymorphism means that a particular operation can be performed on more than one type of object.

Inheritance refers to the ability to create new objects (or, more properly, classes of objects) that take over all (or optionally part—so-called "partial inheritance") of a previously defined object.

Strictly object-oriented languages, such as Smalltalk, and languages that have strictly object-oriented extensions, such as C++, do offer enormous advantages over ordinary programming languages. C++, in particular, is well on its way to becoming crucially important in system development. Object-oriented extensions for other languages are sure to follow.

OOP and encapsulation, polymorphism, and inheritance can provide important benefits. However, they are not the only means to effective higher-level software development. A tool is not automatically useless simply because it does not meet the strict criteria of OOP.

Products like *HyperCard* for the Macintosh or Asymmetric's *ToolBook* for IBM and compatible systems do not meet the strict OOP criteria. Yet, they do enable the manipulation of what we would ordinarily call objects at a much higher level than do traditional programming languages, and they can be tremendously useful tools.

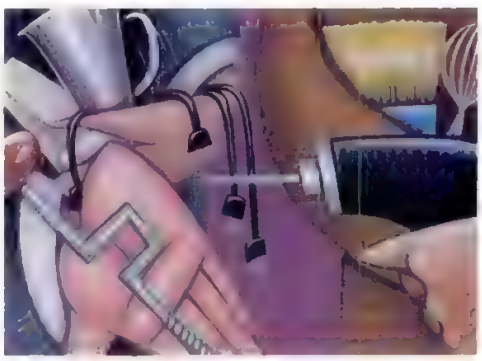

ILLUSTRATION SHANNON JEFFRIES

Similarly, products like Microsoft's Visual Basic or Within Technologies' excellent and more powerful Realizer also fail to meet the narrow object-oriented criteria, but they still provide powerful facilities to develop even large, complex, and sophisticated applications.

Despite the virtues of object-oriented systems, it doesn't make sense to insist on conformance to the narrow technical definition of "object oriented." The best criterion by which to judge a tool is its suitability to the job one needs to do. ■

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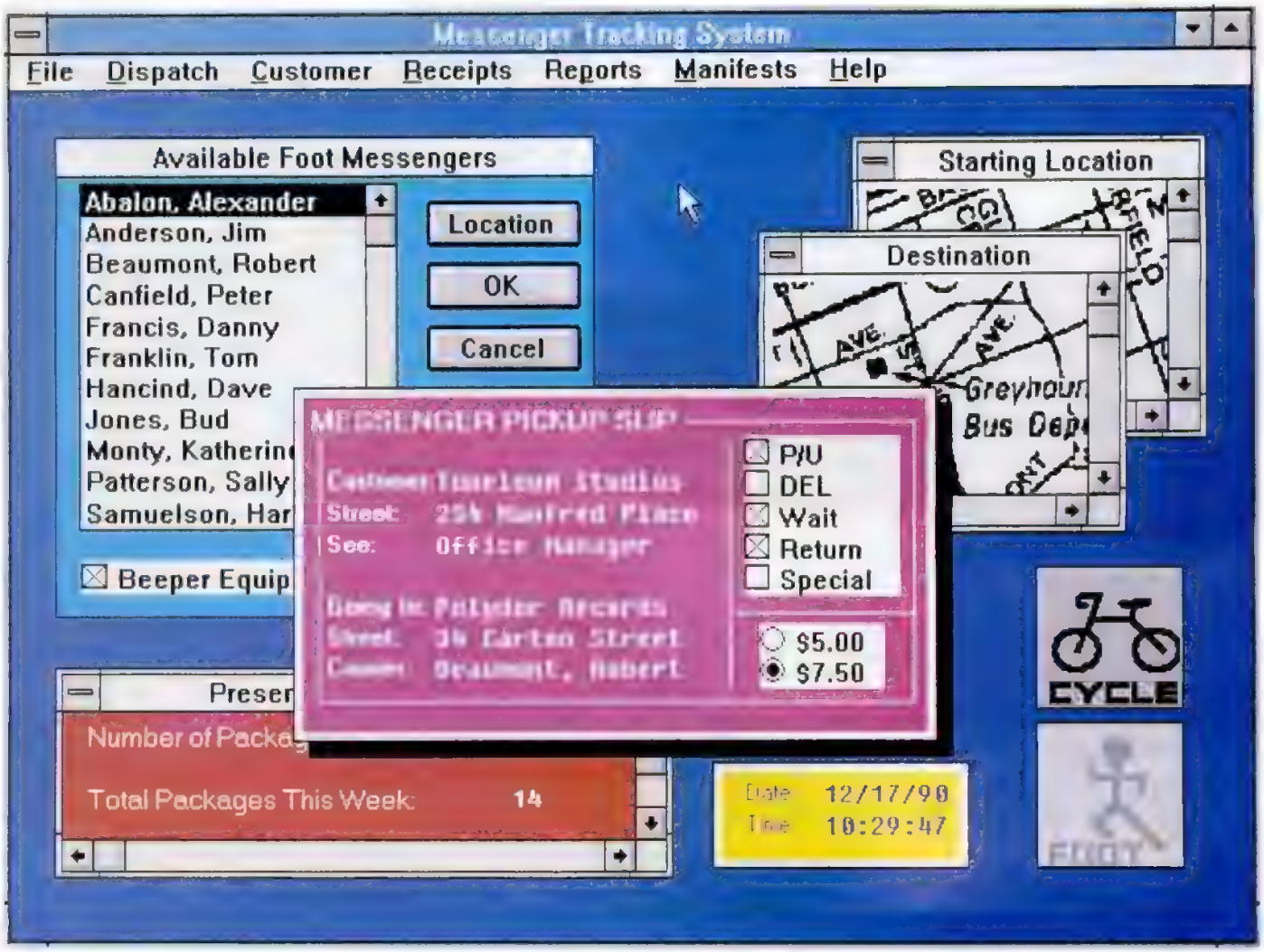

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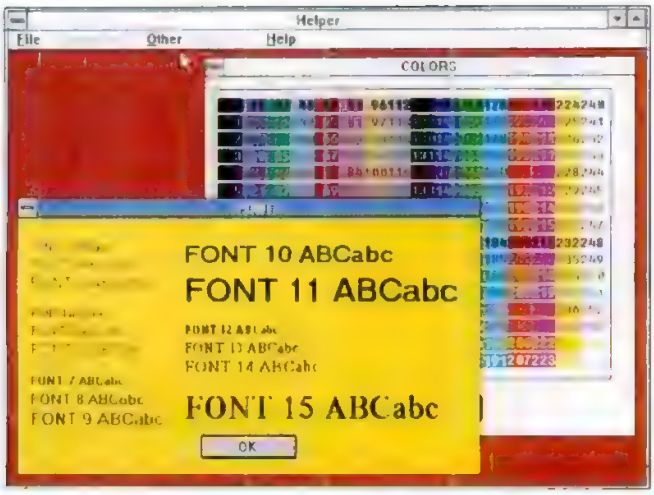

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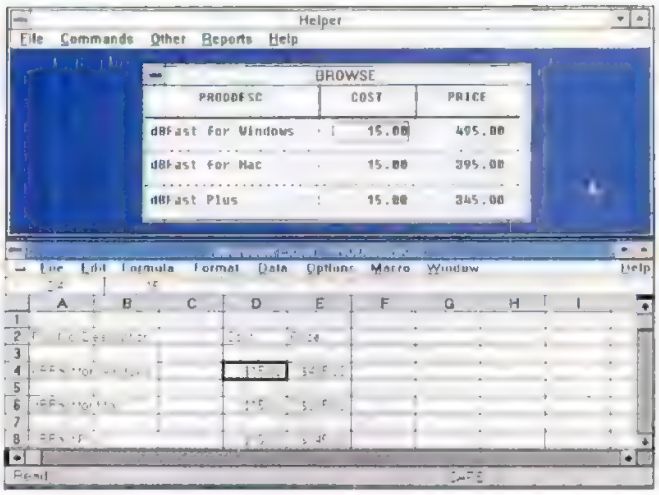

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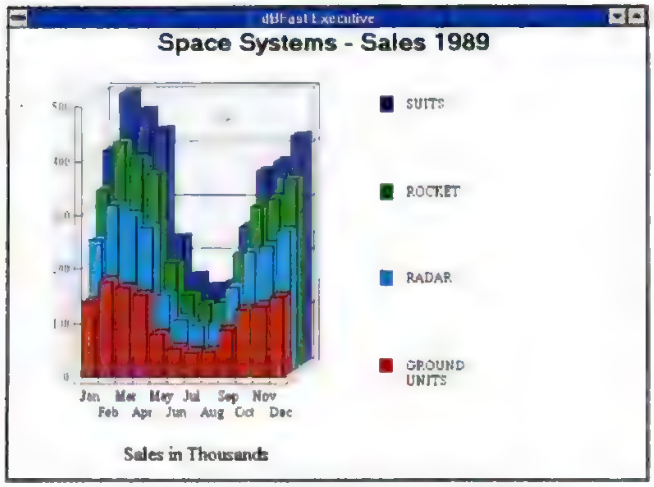

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CIRCLE 348 ON READER SERVICE CARD

PHOTOGRAPHY RICK BECKER

8th Annual Printer Issue

PC Magazine Labs tests 106 printers, bringing our grand total to 819. New this year: a desktop laser that prints 600 dots per inch, network printers, fast ink jets, a solid-ink printer with four-color output, and scalable fonts for dot matrix printers.

Whenever you read a glowing report on the inevitability of the paperless office, that's a perfect time to call your broker and buy another 100 shares of Crane, Hammermill, International Paper, Nekoosa, Xerox, or any company that makes paper, photocopiers, printers, staplers, or yellow highlighters. Paper will be with us for a long, long time. The 100-plus new products in *PC Magazine*'s annual review of printers are one more piece of evidence.

Each of these printers is dedicated to producing more, faster, cheaper, and better-quality output than its predecessors. How much output? A lot. An 8-page-per-minute laser printer left running 8 hours a day would produce 14 acres of

by BILL HOWARD

output over the course of a year (somewhat less if it is printing under *Microsoft Windows*). Multiply that by the 2 million laser printers sold this year plus another 6 million dot matrix and ink jet printers and you've got a respectable-size pile of paper.

But seriously.

There is little in the way of revolutionary new printer technology this year, and there is plenty of evolutionary improvement. Here are some of the key trends worth noting:

Cheaper printers. Two years ago, the idea of a $1,000 (street price) laser printer was astounding; within a year, the $500 laser printer may be upon us. Scalable-font laser printers are available for $1,000 to $1,500. You can find a handful of 24-pin dot matrix printers for less than $200 and 9-pin printers for less than $150.

Decline of the dot matrix printer. The dot matrix printer market peaked in 1989 and 1990 and will decline by half over the next five years. The hardest hit will be 9-pin dot matrix printers.

Scalable fonts are in, but whose? Adobe PostScript, HP Intellifont, and Microsoft TrueType each have pros and cons. The majority of laser printers have scalable fonts built-in, or you can add them for a relatively inexpensive price. Epson America breathed some life into the dot matrix market with a series of three scalable-font printers.

Hot speciality printers. Network printers have arrived, led by Hewlett-Packard Co. (no surprise here). High-quality color printers are moving down into the $5,000 to $10,000 range; the

PRINTER DECISION GUIDE: WHAT TO BUY

What type of printer is best for you? Here is a summary of the pros and cons of dot matrix, ink jet, desktop laser, shared laser, and color PostScript printers. These categories define the capabilities of most printers; unusual units may fall outside these descriptions.

	Dot matrix	Ink jet	Desktop laser	Shared laser	Color PostScript
Pros	Low-cost output. Can handle multipart forms and paper sizes up to 11 by 16 inches; line printers may handle even wider sheets.*	Ultraquiet and compact. Excellent print on paper up to 17 by 23 inches. Speeds increasing as costs decrease; some models even have color.	Great print quality; very quiet; steadily decreasing prices. Most support scalable fonts.	Great print quality and very high speed (especially with direct network hookups). May handle 11- by 17- inch paper, multiple bins, and even auto-sensing.	High-quality color output at high resolution (300 dpi). Can sometimes approximate color photographs.
Cons	Noisy. Print quality only average; limited by a lack of fonts and by slow LQ modes.	High per-page costs; output subject to streaking from moisture. Only a small price advantage over lasers.	Significantly higher cost per page than dot matrix.	Require a network; harder to set up and maintain than desktop printers. Output is not within arm's reach.	Bulky, with high hardware and page costs. Output not quite on a par with photographs; extremely slow.
Speed	25 to 200 cps (0.4 to 0.8 ppm);** line printers can be faster.*	25 to 200 cps (much improved this year).	Personal, 4 to 10 ppm; desktop, 8 to 10 ppm.	10 to 25 ppm.	1 ppm
Cost (street prices are 10 to 30 percent lower)	$200 to $1,500 (usually under $1,000); line printers, $2,500 to $7,000	Portable versions, $500 to $750. Desktop versions, $750 to $1,250	Personal, $1,000 to $1,600; desktop, $1,500 to $3,000. PostScript, $500 to $1,000 extra.	$3,000 to $20,000, direct network connection, up to $1,000	A-size models, $7,000 to $12,000 B-size models, up to $15,000
Cost per page	$0.005 to $0.01 ***	$0.05 to $0.08.	$0.02 to $0.04.	$0.02 to $0.04.	$0.50 to $1.00
Output quality	24-pin LQ, very good; 9-pin printers, fair or poor.	Almost laser quality.	Excellent text; good graphics; poor photos.	Excellent text; good graphics; poor photos	Great color, but not perfect.
Color	Via upgrade or special version; requires four-color ribbon.	Some models; quality improving.	Not available.	Only in the $83,050 Canon CLC-500	Standard
Noise	Loud and buzzy; slow in quiet mode.	Virtually silent.	Quiet	Quiet	Quiet
Size	Narrow-carriage models fit easily on a desktop, some are small enough to take on the road	Fit on desk corner; usually only a few inches high. Portable models fit in briefcases.	Start at 11 by 13 inches; may be slightly too big for the average desktop.	Range from desktop-size to so bulky that they require a separate stand or desk	Very bulky; can overwhelm a small office
Paper	Tractor-feed paper or continuous multipart forms; cut sheets.	Cut sheets. May need coated stock for top-quality output.	Cut sheets, overhead film, labels, envelopes.	Cut sheets, overhead film, labels, envelopes.	Coated stock or film required (except for the Tektronix III PXi).

* Line printers are large special purpose dot matrix printers with very high speeds high duty cycles, and the ability to handle large paper widths They tend to be noisy unless shielded

** While laser print speed is not directly comparable with the speeds of dot matrix or ink jet printers, a score of 1 page per minute falls roughly within a range of 25 to 30 characters per second (for double-spaced text) or 50 to 60 characters per second (for single-spaced text)

*** Industry convention excludes the cost of paper (about 1 cent per sheet) from per-page costs.

personal color printer market will heat up with HP's new $1,095 DeskJet 500C. Laptop users have even more intriguing choices, including a near-HP-LaserJet-quality printer hardly larger than a portable cellular phone. (Yes, it's slow. You can't have everything.)

Here is a bit more detail on the state of the printer market today and where it is headed next year.

LASER PRINTERS

Last year, HP was the biggest seller in the laser printer market. This year, HP is the biggest seller in the laser printer market. Next year, HP . . . you get the picture. By some estimates, HP will sell more than a million laser printers this year. HP provides tough competition, since it's hard to beat any HP product on quality, durability, or reputation, and in the case of laser printers, it is also tough to beat HP on price. Last year was the year for a new mainstream HP 8-ppm laser printer, the scalable-font HP LaserJet III. This printer features Resolution Enhancement Technology (RET), which smooths jagged edges on fonts and graphics as if the printer operated at 400 dpi or so. This year, it was the 4-ppm upgrade of HP's LaserJet IIP (as in Personal), LaserJet IIIP, and networkable 17-ppm LaserJet IIISi—each with scalable fonts and RET, and each of them an Editors' Choice in its category. And as we went to press, HP was readying a replacement for the LaserJet IIP. At a list price of $1,249, the LaserJet IIP Plus will add a faster processor and subtract $50 from the list price of the discontinued LaserJet IIP.

Sound invincible? Almost, but not quite. HP has a few chinks in its armor. For starters, while all current HP printers can be adapted to run Adobe PostScript, all except the LaserJet IIISi do a lousy job of switching back and forth. You have to turn off the printer, insert the $695 PostScript cartridge, turn the power back on, and wait 2 minutes while the printer performs a laborious self-test. Most competitors' printers can switch with a software command, and a few—QMS, for instance—do it automatically on a case-by-case basis. And you will want to switch: While PostScript is more robust, HP PCL is miles faster at what it can do.

Two other vendors—Dataproducts Corp. in the desktop laser printer category and Tektronix in the color PostScript printer category—have Adobe PostScript Level 2, which promises more functionality and more speed. An increasing number have RISC processors from AMD, Intel, or Weitek to speed the formatting of complex pages.

Who is the competition for HP? According to Infocorp (a Santa Clara, California, market research firm), it is IBM Corp./Lexmark, Apple Computer Corp., Panasonic Communications & Systems Co., Canon USA, Texas Instruments, QMS, NEC Technologies, Kyocera, and Epson America, roughly in that order. Apple printers are capable of working with PCs as long as you don't plan to use a parallel printer connection. IBM has solid units, but none are faster than 10 ppm. Panasonic printers are nothing special to look at, but they often provide 50 percent more engine speed than the competition at a given price. We reviewed 35 desktop laser printers in this issue, including the $1,595 scalable-font HP LaserJet IIIP; the $1,999 Okidata OL830 PostScript printer; and the $1,895 IBM LaserPrinter 6 and $2,395 LaserPrinter 10, with PostScript options that produce 600 dpi.

SHARED PRINTERS

By next year, a third of all laser printers will be connected to a network, Infocorp estimates, and the network printer category will show sales growth three times as great as the printer market as a whole. With that in mind, this year we have created a separate review category for shared printers.

In the past, network printers have often been run-of-the-mill laser printers—most typically 8-ppm HP LaserJet printers or compatibles—that were attached to network nodes. True network printers have a network adapter card built-in and can be directly connected to the network's coaxial or twisted-pair cabling. This allows for faster data transfer than a parallel printer cable (and is far, far faster than using a serial cable). A network connection also offers the potential (potential more than reality for now) for the printer to pass back to your PC messages more sophisticated

PRINTER MARKET: BOOM TIMES FOR LASERS AND INK JETS

This year, the U.S. market for printers is more than 8.4 million units. Dot matrix sales are in a slow decline (this is more obvious for 9-pin printers than for 24-pin printers), while sales of laser and ink jet printers are up substantially. "Other" printers include categories such as thermal wax transfer color PostScript printers.

U.S. PRINTER SALES, 1989 to 1992
in millions of units

Year	1989	1990	1991	1992
Dot matrix	5.2	5.3	5.1	4.9
Ink jet	0.6	0.7	1.0	1.3
Laser	1.1	1.8	2.0	2.2
Other	0.3	0.3	0.2	0.2
Total	7.2	8.1	8.3	8.6

Source: BIS Strategic Decisions

LEADING MANUFACTURERS

	9-PIN DOT MATRIX	24-PIN DOT MATRIX	LASER
1.	Epson	Panasonic	Hewlett-Packard
2.	Panasonic	Epson	Apple
3.	Okidata	Citizen	IBM
4.	Star Micronics	Okidata	Panasonic
5.	Citizen	IBM	Epson
6.	IBM	Star Micronics	NEC
7.	Apple	ALPS	QMS
8.	NEC	NEC	Okidata
9.	C. Tech	Fujitsu	GCC
10.	Fujitsu	Toshiba	Texas Instruments

Source: IDC (1990 unit sales)

than the current "Error" or "Check Printer" error messages. Typically, they have RISC processors for imaging pages in a hurry, fast engines (at least 10 ppm, typically 15-plus ppm) to spit out the pages once they are imaged, and several big paper bins. Some shared printers offset each print job by an inch so users don't mistakenly take the first several pages of someone else's printout. Some can print on both sides of the page; some print on 11- by 17-inch pages.

In this issue, we review ten such printers, from Eastman Kodak Co., HP, IBM, Kyocera, LaserMaster Technologies Corp., NCR Corp., Printware, QMS, Sharp Electronics Corp., and Texas Instruments. Each costs between $5,000 and $20,000.

The shared printer market doesn't stop there, though. Xerox, for instance, sells a $220,000 laser printer, called the DocuTech, that is somewhat more feature-rich—to put it mildly—than the shared printers reviewed here. (Kodak has a similar 92-ppm system called the LionHeart.) The DocuTech can best be described as a printer (plus photocopier, scanner, keyboard, mouse, video display, and gobs of memory) where you feed a tree into one end and get collated, bound, and stapled documents out the other end—at 600-dpi resolution, 135 ppm, and up to 11- by 17-inch paper. No one who's seen DocuTech in action hasn't walked away impressed. But more than a few people who have seen it wish for something with DocuTech's features scaled back from a 500,000-page-per-month (minimum) enterprise solution to a device in line with the needs of a single department—perhaps 50 ppm (plus collating and stapling) for $50,000. If IBM, Kodak, or Xerox doesn't build one first, Japan Inc. will oblige.

Sharing a printer among several PCs is much easier these days, and not just for the network-oriented shared printers. Several laser printers allow you to connect them to PCs by both the parallel and serial interfaces; the printer buffers one print job while it prints the other. A half-dozen vendors produce remote LAN connections: modem-size boxes that let you attach a printer directly to the network cabling without dedicating an old PC to the task. Products include the Castelle LANpress, HP 33480 LAN Connection, Intel NetPort Print Server, and Microtest LANport II. *PC Magazine* reviewed five of these devices—also called special function servers, or Ethernet (or Token-Ring) peripheral-sharing devices—in the January 15, 1991, issue; another review is scheduled for early next year. And you can also use tried-and-true printer-sharing boxes (smart switchers) from companies such as Black Box Corp., Buffalo Products, Digital Products, Fifth Generation Systems, and Rose Instruments, among others.

DOT MATRIX

Innovation is hard to come by in dot matrix printers these days. Much of the research and development efforts centers around squeezing a few more construction-cost dollars out of each unit. While the very cheapest units feel tinny, they work fine for routine single-user office printing, and who can argue against 9-pin printers that cost less than $150 or 24-pin units under $200? Low-cost printers haven't become commodity items, but

GOING MOBILE: Portable Printers

This year's four portable printers span the full gamut of technologies, including dot matrix, ink jet, and page printers.

by Oliver Rist

As befits traveling hardware, this year's troop of portable printers are all over the place—at least all over this issue. Last year, the only laptop printer reviewed fell into the ink jet section, the trend-setting and Editors' Choice–winning $499 Canon BJ-10e (reviewed in our November 13, 1990, issue); this year, such printers are everywhere, from page printers to dot matrix printers.

The best of the 1991 portable printers is a dot matrix printer, the Citizen PN48 (reviewed in this issue's dot matrix section). This tiny marvel is roughly the size of a carton of cigarettes, weighs only 3 pounds with its nickel cadmium battery installed, and sells for $469. Though it prints slowly and you must hand-feed every sheet, its thermal wax transfer printing technology provides such excellent output quality, and its size is so convenient, that it was the clear Editors' Choice winner. The other dot matrix portable we looked at is the $499 24-pin Seikosha LT 20 (reviewed in this issue's section on dot matrix printers). Designed to fit under your laptop as a sort of platform, the 6-pound LT 20 is nowhere near as tiny as the PN48 (at 2 by 15 by 11 inches). It is just about as slow, however, at only 24 characters per second. And with its print quality falling short of the PN48's output, the LT 20's only redeeming feature is the ability to handle multipart forms.

There was only one portable ink jet printer this year, the $499 Star Micronics StarJet SJ-48 (reviewed in this issue's section on ink jet printers). Based on the same 64-nozzle engine and 7- by 12- by 9-inch case as the Canon BJ-10e, the StarJet replaces that printer's Canon BJ-330 emulation with Epson LQ-850, adds an auto-loading feature, and includes a two-year standard warranty.

Mannesmann Tally took the high-powered executive route to portable printing with its thermal page printer, the $1,295 6-page-per-minute MT735 (reviewed in this issue's section on desktop laser printers). The 2- by 11- by 9-inch MT735 looks like a miniature dot matrix printer and weighs 8 pounds. Though it is pricey and somewhat big for a portable, if you need speed and graphics capability while traveling, it may be worth the tradeoff.

With the surge in portable-printing popularity, a few product trends did develop. Notably, Canon USA is OEMing its portable ink-jet engine in the same vein as its now-widely-used laser engine. Also, the need for special paper has been eliminated. Unlike the venerable Kodak Diconix 150 Plus (reviewed in "Portable Printers: On-the-Road Output," November 14, 1989), this year's portable crop requires no special clay-coated paper to produce high-quality print. With all these portable improvements, who knows? We may do away with office buildings in a few years. ■

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An optional cable is required for Macintosh, the C8IM2

M4-PC

CIRCLE 746 ON READER SERVICE CARD

there is a certain similarity to many of the units. And while low prices may be music to the ears of printer buyers, to the makers of dot matrix printers, the music signifies musical chairs. Two years from now, there may be fewer chairs to sit in. Don't be surprised to see one or more vendors pull out of the business.

Fortunes ebb and flow from year to year, but Epson, Okidata, and Panasonic appear to have some of the best product mixes for now. Epson and Okidata have done a good job selling low-end 9-pin printers not only to PC users but to service environments where the PC may be disguised as a cash register or airbill printer. Panasonic has done well in the 24-pin market. Panasonic's KX-P2624 represents a step forward in quiet dot matrix printing. This is a higher-end ($500 street price) 24-pin wide-carriage printer that produces 10 to 20 percent less noise than other dot matrix printers. The company also has a dirt-cheap 24-pin unit, the KX-P1123, with a price hovering around $200. With prices like that, it's clear why 9-pin printers are in trouble.

Dot matrix market leader Epson has retired its LQ-800/1000-series 24-pin printers after half a decade of service. The replacement LQ-870 and LQ-1170, plus the personal LQ-570, include a scalable-font technology called ESC/P2 that works like PCL 5 or PostScript, albeit on a far more modest scale; you can scale fonts only from 8 to 32 points. Epson says each printer "comes with a free diskette containing drivers for *Microsoft Word, Windows, WordPerfect, WordStar,* and more," but PC Labs found the *Windows* part to be a bit misleading. The printer works under *Windows*, but the scalable fonts don't. If you want scalable fonts, you have to buy a software product such as *Adobe Type Manager*, which does font scaling (to 127 points) with any dot matrix printer.

In a market that is not expanding, there have to be losers along with winners. Alps America, Citizen America Corp., IBM/Lexmark, and Seikosha America have seen retrenchment in at least some segments of their dot matrix printer businesses. Alps, for instance, didn't have any new printers for review this year.

The dot matrix market isn't all gloom and doom. Dot matrix printers will always produce output for less than laser printers, roughly a penny a page versus 2 to 4 cents a page. And wide-carriage printers loaded with 14 7/8- by 11-inch paper can swallow massive spreadsheets better than laser printers can.

FORMS AND LINE PRINTERS

Businesses printing thousands of invoices a week need fast, durable printers that can print multipart forms. If the output is crisp and the printer is quiet, so much the better. Line printers are grouped in with the other dot matrix printers, but they are a breed apart, costing at least $2,000 and running at 200 to 500 characters per second. There are actually two groups here: fast, very-heavy-duty dot matrix printers from Genicom Corp. and IBM, and even faster, pricier speciality units from CIE America, Mannesmann Tally Corp., and Printronix. (The latter category includes printers that accept the same commands as line printers, as well as more-common printer codes, even though they are not technically line printers because they don't print the entire line at once.)

COLOR POSTSCRIPT PRINTERS

A dollar a page isn't too much to spend if you need half a dozen color overhead transparencies in the next half-hour, or if you need a color proof of your upcoming ad campaign. The nine color PostScript printers reviewed here give you fairly fast access to relatively faithful color prints and transparencies. If the color is not as good as an 8- by 10-inch glossy color print or a printer's Chromalin proof separation, it is still pretty darn good.

Tektronix this year has released a phase-change solid-ink printer, the Phaser III PXi, that is especially well suited for printing on all kinds of paper. Most other high-end color printers are thermal wax transfer devices that work best with coated stock or clear acetate. The Phaser III PXi's technology, in crudest terms, involves melting colored wax sticks (they feel like crayons and you can draw with them if you're so inclined), spraying the color on the sheet, and then flattening the wax onto the paper by using a heavy roller. While this process sounds simple, making it work well has been no easy feat.

For those users who want simpler and cheaper color output, there are color ribbons for most dot matrix printers, color toner cartridges for laser printers (brown or blue, one color per cartridge), and the venerable HP PaintJet. New this year are color ink jet printers from Mannesmann Tally (the MT92C, $2,995) and HP (the HP DeskJet 500C, $1,500). Neither was available in time for review; however, looks at preproduction units suggest they will split the difference in quality between low-end color devices and the $5,000-plus thermal wax transfer printers.

PORTABLE PRINTERS

If there's one area that is truly innovative this year, it is the battery-powered portable printer. The Kodak Diconix pioneered the market several years ago, although this printer is fading in the wake of better technology. Canon's BubbleJet BJ-10e, an Editors' Choice winner last year, is the current leader in price, performance, and quality. Two new printers produce sensational print quality. The $469 Citizen PN48 is not much bigger than a portable cellular phone, yet it produces essentially laser-printer-quality output—at a leisurely 25 cps. As for speed, the Mannesmann Tally MT735 produces 6-ppm output from a unit the size of a ream of paper.

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Application backlogs.

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HOW WE TESTED THE PRINTERS

PC Magazine Labs' printer test suite is a delicate balancing act between old and new. At the core is our text speed test, which dates back to 1984. Brand new is an HP PCL 5 torture test.

by Mary Kathleen Flynn and Michael J. Zulich

As the largest and longest-running *PC Magazine* project, the annual printer issue offers many challenges. These range from mission-critical questions, such as deciding which products to include in the review, to mundane concerns, such as figuring out where to *put* the 100-plus printers that come through our doors every summer. But each year it is the test suite that inspires the most passionate feelings.

Similar to the debate raging on college campuses about updating the traditional canon, we argue about how much we should change our tests. What role should backward compatibility play? Because this ongoing project spans nearly a decade of products, the test suite has to be static enough to produce consistent results across the years, while at the same time it must be flexible enough to keep up with changing technologies and new features.

BACKWARD COMPATIBILITY

This year, many of the decisions we made favored tradition. The test suite has been a work in progress since 1984, with PC Labs' technical director Robert W. Kane and contributing editor Bill O'Brien as the principal architects. The core of our test suite, which takes up over 30MB of RAM, is our text speed test. Known affectionately as the Arthur D. Author test, it consists of a two-page business letter. For dot matrix and ink jet printers, the test file contains one copy of the letter; we print this twice and then average the scores. Results are reported in characters per second (cps).

For page printers (laser, thermal wax transfer, and solid-ink units), the test file contains ten copies of the letter in order to minimize the overhead of printing the first page. We run the test twice and average the scores. Test results are reported in pages per minute (ppm). We also run a one-page-out test (new last year) to show you how long you will have to wait for laser printers and their brethren to print the first page. Results are reported in seconds.

Line printers, which we review in the dot matrix section, are designed for high-volume applications and therefore use the same test file as the laser printers. They print one line at a time, and the results are reported in lines per minute (lpm).

One question we're often asked is, "Why do you keep using that old photo of Flynn?" We do this for the same reason we still use the Arthur D. Author letter: so you can compare this year's products with those from last year and previous years before that. The photograph was taken in 1988 by our principal photographer Thom O'Connor, who shot all the printers for this issue (as well as about 500 printers for previous issues). The scanned image contains many shades of gray and doubles as our graphics speed test; the results are reported in graphics pages per minute (gppm). We also report in minutes and seconds the time each printer takes to print the file.

Because it is not a speed test, the text sample we publish in the Printer Guides

HOW TO READ THE PRINTER GUIDES

Text Speed
Our text speed test is a two-page business letter. Dot matrix and ink jet speeds are reported in characters per second (cps), page printers (laser, thermal wax transfer, and solid-ink units) in pages per minute (ppm), and line printers in lines per minute (lpm).

Graphics Speed
The scanned photo of associate editor Mary Kathleen Flynn doubles as our output sample and our graphics speed test. Results for all printers are in graphics pages per minute (gppm).

Graphics Time
A different way of expressing the graphics speed, this test tells you how long the printer took to print our graphics image, in minutes and seconds.

One Page Out
This test reports in seconds how long it takes a single page to print. After the printer idles for 30 seconds, timing starts from the moment the page enters the printer until the page drops into the printer's output tray.

changes from year to year. The PC Labs staff dug up this year's quote.

We ran the speed tests in all emulations that came standard with each printer, and we report the results from the primary emulation. For printers that came with HP PCL and PostScript compatibility, we report test results in both modes. You will see that the graphics scores in PostScript mode are slower than they are in PCL mode. In part, this is because PostScript Level 1 is inherently slower, but it is also because our test file is larger in PostScript mode than in PCL mode. In supplemental testing, we ran some PostScript options through our test suite.

NEW TORTURE TEST

New this year is our HP PCL 5 compatibility test, which is written by contributing editor Alfred Poor (who also developed our original PCL torture test). Both the PCL 4 and PCL 5 tests utilize common and not-so-common PCL functions, such as nested macros in PCL 4, scalable fonts, orthogonal printing, HPGL, and PCL 5 compression modes (1, 2, 3, and 5).

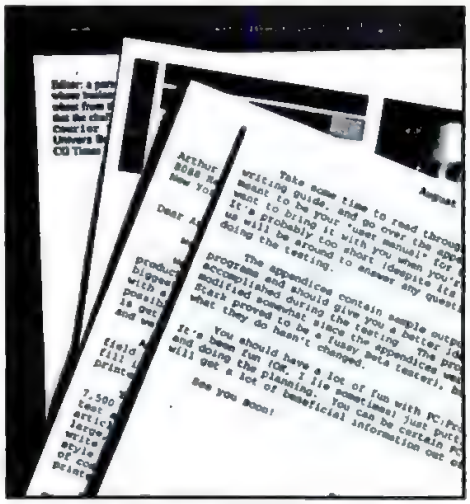
PostScript Level 2 had not been out long enough for us to develop tests that would fully exercise its functions. Only three printers used PostScript Level 2: the Dataproducts LZR 960 and the color-PostScript Tektronix Phaser II PXi and Tektronix Phaser III PXi.

Also, don't expect to see the impact of RISC processors or SCSI adapters on our results; our tests don't take advantage of these features.

We tested printers in five categories: desktop laser printers, shared laser printers, color PostScript printers, ink jet printers, and dot matrix printers.

The shared laser printer category is new; ten laser printers aimed at networked environments were introduced during the past year. Although you might think a new category would demand a new testing strategy, we discovered earlier this year that print speed is limited by the printer's engine and not by the network's speed or topology ("Get Serious: Smart Printer Sharing with the HP LaserJet IIISi," *PC Magazine*, May 28, 1991). In addition, none of the high-volume, high-speed printers provide a built-in network adapter as standard equipment, and only a few of them offer it as an option. To keep the playing field level, we tested these devices as though they were attached to a print server by using our standard test-bed Compaq Deskpro 386/25e and the system's parallel port.

Color PostScript printers underwent the same test suite as desktop laser printers and shared laser printers—except that we made them print in six colors (blue, red, magenta, green, cyan, and yellow) instead of gray scales. Since most color PostScript printers cannot fill the entire page, we measured the printable area. Look for a printer with a printable area above 80 square inches.



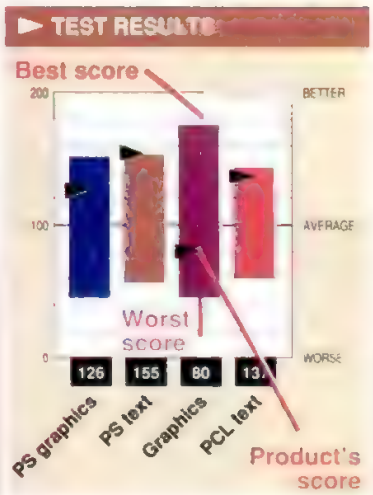
PC Magazine Labs' printer test suite: text speed, text output, and graphics speed.

A handful of printers were unable to print one of our tests; the portable Citizen PN48, for instance, uses thermal fusion technology and therefore does not have a draft mode. The EiconLaser, which uses a PC controller, was unable to handle the size of our graphics file without a utility provided by the company. These printers receive an "N/A" (for not applicable) in the Printer Guides, in place of a result, and a 0 as a score in the high-low-average charts.

Perhaps the most obvious difference between this year's issue and those in previous issues is the graphics that accompany each review. The Fonts & Features boxes have been replaced by high-low-average charts. (A full features table in each section will tell you all about fonts.) Borrowed from a diagram that associate graphics director Gary W. Kaplow developed for PC roundups, this new chart allows you to see test-by-test how each printer's performance compares with the performance range of all the printers in its class. The average score is set to 100; printers that performed above average, for example, will have scores over 100. But don't start sending executive editor Bill Howard entries for the Abort, Retry, Fail? column. These numbers are *supposed* to be different from the cps, ppm, and gppm ratings. ■

HOW TO READ THE HIGH-LOW-AVERAGE CHARTS

Relative Scores, Not Actual Speeds



THE BARS

The high-low-average charts show each printer's scores on our performance tests relative to the best, worst, and average scores of printers in this issue. Each colored bar represents the range of test scores for printers of the same type, from fastest to slowest. The longer the bar, the wider the range. If the best score is more than twice as fast as average, an upward-pointing arrow appears atop the colored bar.

A black arrow on each bar represents the given printer's position within the range. The higher the arrow, the better the performance. If the printer performs more than twice as fast as average, the black arrow appears at the top of the bar, pointing upwards.

THE BOXES

A normalized score appears in the box below each colored bar. This number reflects the printer's position compared with others in its class, on a scale where the average score is 100 and a larger score indicates proportionally better performance.

For the printer's actual speeds (measured in cps, lpm, ppm, or gppm), turn to the three-dimensional charts on the performance test pages in the appropriate section of reviews.

If you are less constrained by space and don't need battery-powered printing, any of the smallish dot matrix printers do a passable job. And if you're really space-constrained, you can use your laptop computer's modem and any of the electronic mail services—AT&T Mail, CompuServe, or MCI Mail—to send a fax to your hotel.

EASE OF USE/BELLS AND WHISTLES

For many users, ease of use is as important as—no, more important than—an extra 10 cps of print speed. As in previous years, the industry is more talk than action.

HP, for instance, includes scalable fonts with its current printers, but these printers are unable to scale the type on a slightly oversize *Windows* spreadsheet to fit onto a single page, or to create multiple *PageMaker* thumbnail pages on a single sheet—something all PostScript printers can do. HP LaserJet printers are technically capable of doing it, but the current *Windows* driver isn't. Maybe next year, HP says.

Panasonic, which trumpeted its KX-P1124 printer's row-column offset front-panel buttons as the last word in ease of use, found that the word most users would use is unprintable and quietly junked it in favor of a more traditional LCD arrangement on its successor, the KX-P1124i.

While it doesn't make life easier for users, IBM has a front-panel innovation that makes life easier for printer salespeople, if not for users. Most IBM/Lexmark dot matrix printers have a button marked Demo, which does exactly what you would expect.

A small but increasing number of laser printer vendors are offering envelope feeder attachments so you don't have to run off and find a Selectric when you need to address an envelope. An even smaller number of word processors now have macros or routines that grab the address off the letter on-screen, then draw an envelope through the manual feed slot; you don't have to figure out the page offsets and margins for an envelope.

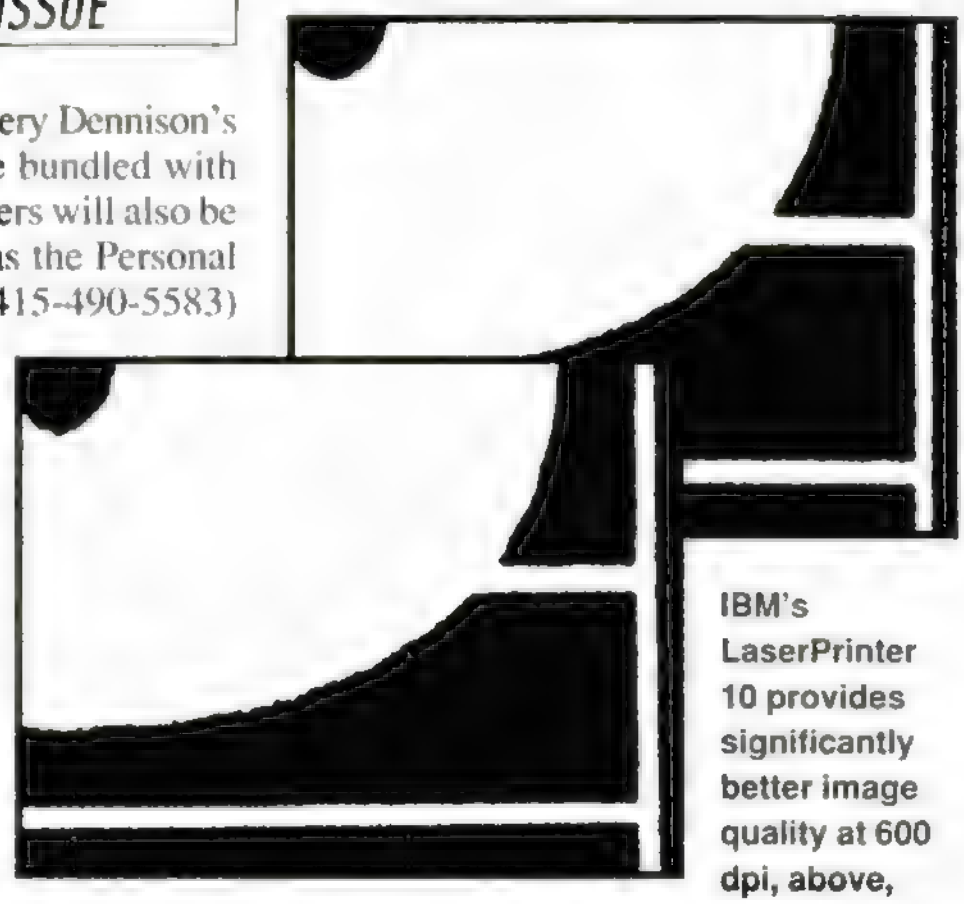
For those who want even fewer hassles, two companies have or will have speciality printers that print only envelopes, labels, or both. CoStar Corp. (203-661-9700) makes a $595 envelope printer (the AddressWriter) and a pair of label printers (the $249.95 LabelWriter II and $399 LabelWriter II Plus) that print on 1 1/8- by 3.5-inch and 2.25- by 4-inch labels, respectively. A version of Avery Dennison's *LabelPro* software will be bundled with the printers; the label printers will also be sold by Avery Dennison as the Personal Label Printer. Tidemark (415-490-5583) plans to market an $1,195 envelope printer, the Address Express. Tidemark contends that its higher price is offset by faster, better-quality printing and a lower cost for consumables. Demonstration labels and envelopes produced by CoStar printers were legible but not letter-quality; print resolution is 138 dpi (for the LabelWriter printers) and 144 dpi (for the AddressWriter).

High-speed envelope printers already exist for companies that need to address thousands of envelopes a week (see "Name and Address for Less: Envelope Printers Cut Your Costs," *PC Magazine*, January 29, 1991). CoStar and Tidemark products are for more-modest needs.

LOOKING AHEAD

More progress and new technology will come over the next year. Some of it was predicted for this year. Laser printers have been stuck at 300-dpi resolution since the original LaserJet arrived, back in 1984. A half-dozen companies do have higher-resolution output, but they only account for a tiny corner of the market. IBM offers the most impressive high-resolution solution we've seen: For about $4,100, you can buy the IBM LaserPrinter 10 loaded up with enough memory to turn the Adobe PostScript option into 600-dpi mode for spectacular output.

The multifunction printer is another once and future product. Also called a hydra device or multifunction peripheral, this concept involves combining a laser printer, scanner, fax, modem, and photocopier into one box, or a box plus a controller box. An intriguing idea for the home, home office, or small business, the multifunction printer also poses a multi-headed threat: When it breaks, you lose your laser printer, scanner, fax, modem, and photocopier all at once. In the meantime, there have been partial solutions. HP offers a pricey but high-quality fax attachment ($1,895) for its LaserJet printers, which could double as a scanner, with an as-yet-unannounced upgrade and software. Kodak includes a 6-ppm convenience copier in its 16-ppm Eastman Kodak Ektaplus 7016 PS. (This is reviewed in the shared laser printer section in this issue.)



IBM's LaserPrinter 10 provides significantly better image quality at 600 dpi, above, than at 300 dpi, below. Insets are enlarged six times to show detail.

ABOUT THIS ISSUE

For our eighth annual review of printers, we divided this issue into five sections: desktop laser printers, shared laser printers, ink jet printers (black-and-white and color), color PostScript printers (the $5,000-plus devices), and dot matrix printers. The high-end dot matrix (line-printer-style) printers are in the dot matrix section. Portable printers are covered in several sections, depending on their engine technology.

Each section is arranged alphabetically by company name; if the company has several printers, they're grouped together in a single review. To be included in our reviews, printers had to be available by early summer. We reviewed only new printers, plus previously reviewed printers that were substantially enhanced. The introduction to each section lists printers that have been announced but were not available to meet our deadlines.

With the 106 printers reviewed here, we've now tested a grand total of 819. To help you compare previously reviewed printers that are still on the market, an index details each one's name, engine technology, print speed, and current price, and the issue and page of the previous review. It naturally includes the printers reviewed in this issue. ■

ORACLE SERVER FOR NETWARE WENT TO SARA LEE AND HAD THE COMPETITION FOR DESSERT.

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Sara Lee Corp. and PC Week Labs.

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"In the end, ORACLE Server [for NetWare] was the only software that met all the stringent requirements for the application...

"While each product competing in the shootout displayed strength in one area or another, ORACLE Server was at or near the top in nearly every competition.

"ORACLE Server's performance shined on database queries that required complex aggregations—sometimes more than twice as fast as other products...

"In selecting ORACLE Server as the winner, the judges considered other factors such as product maturity and experience with corporate databases, and the selection of front-end tools to access the database.

"(And) even though the NLM version of ORACLE Server was new, it was considered to be a close extension of the firm's OS/2 and Unix products, which are proven technology on client/server platforms."

—PC Week June 24, 1991

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PC Magazine caught us speeding.

"PacificPage XL beats HP on LaserJet PostScript printing"

PC Magazine, June 25, 1991

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PacificPage XL is fast. So fast, that PC Magazine has cited it for exceeding the speed limit of Hewlett-Packard's PostScript® Cartridge by more than six times.

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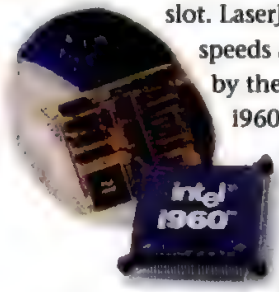
How do we get it to work so fast? It's really quite simple. We've taken our award-winning PostScript language emulation cartridge called PacificPage P•E, and combined it with a high speed accelerator board that installs easily into your LaserJet IIP, III, IIID or IIIP printer memory slot. LaserJet printing speeds are boosted by the fast Intel i960™ RISC processor that's mounted on the board alongside 2 MB of printer memory.



"An Intel i960 RISC processor on the accelerator board helps the PacificPage XL print graphics more than six times as fast as the HP PostScript Cartridge."

Do you use a shared printer? If you do, you'll definitely want the speed of PacificPage XL. Because output is printed so fast, other users won't have to wait for their jobs to print.

Make a quick price/performance comparison and you'll see — PacificPage XL is the smart choice!

35 POSTSCRIPT COMPATIBLE FONTS

Acquiring stylish, professional looking output is easy with PacificPage XL. Because we've included 35 fully scalable Apple LaserWriter equivalent fonts. These high quality Bitstream designs provide you with the tools you need to create output that shines. For even greater versatility, PacificPage XL supports Bitstream's Speedo fonts and Adobe Type 1 and 3 fonts.

COURIER
SWISS
SWISS NARROW
DUTCH
ZAPF CALLIGRAPHIC
GEOMETRIC
REVIVAL
CENTURY
CHANCERY
Zapf Dingbats
✱✲❶✂✓★✚❷✧
Symbol
↔Δ•ΦΓ∝ΥΝΧ≠

Each typestyle comes in normal, bold, italic and bold italic treatments except for Chancery, Zapf Dingbats, and Symbol

"The native 35 PostScript compatible fonts in PacificPage XL are Bitstream designs, some of them superior to Adobe's version."

100% POSTSCRIPT LANGUAGE COMPATIBILITY — GUARANTEED

Many LaserJet users believe that only true Adobe PostScript gives true PostScript capabilities. The truth is, PacificPage XL provides exactly the same graphics capabilities for your LaserJet as Adobe PostScript. Exactly. So you can pay less and, in addition to speed, get all of PostScript's powerful graphics functions. We're so sure of it that we give you our money back guarantee of satisfaction.

PostScript file output from LaserJet III with PacificPage XL

"PacificPage XL swiftly and accurately renders some test EPS files that other interpreters distort and had no trouble with any of the large and complex images used for testing."

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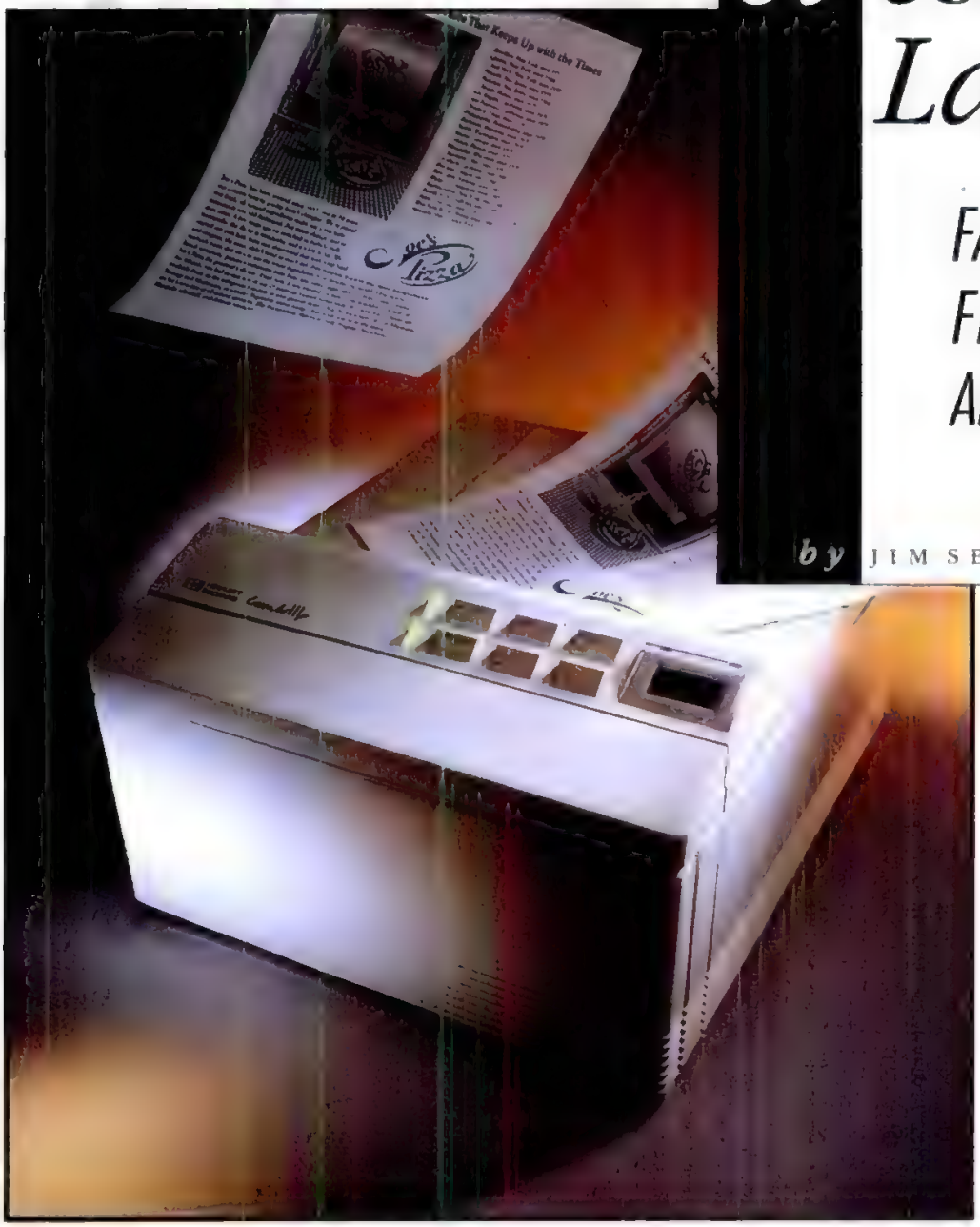
desktop Lasers

FAST, FLEXIBLE, AFFORDABLE

by JIM SEYMOUR



PHOTOGRAPHY: RICK BECKER

These 35 desktop laser printers provide clear alternatives to HP's dominant LaserJet III: lower prices, faster output, smaller footprints, higher resolution, more-efficient processors. And PostScript comes standard on two-thirds of these 4- to 10-ppm printers.

Ho hum. Faster, smaller, cheaper. More of the same. The laser printer market rolls along every year, with those imperatives controlling its growth. And again this year. . .wait a minute!

This year, laser printers also got slower, bigger, and more expensive—much more expensive in a few cases. We have finally broken away forever from the 6-page-per-minute paradigm: the notion that every

self-respecting laser printer ought to be an HP LaserJet II clone, if maybe a little smaller, cheaper, and slower.

You can find most of those high-speed, high-dollar laser printers in Frank Derfler and Steve Rigney's look at shared laser printers. Here, however, we look at 35 desktop laser printers (from 22 vendors) that are really intended for single users or for simple sharing in a very small workgroup.

In many offices, smaller and less expensive printers such as these 35 are a better alternative to larger, faster, networked printers shared by many users. Users with heavy printing needs are often better served by having a dedicated printer; even the once-in-a-while laser printer user appreciates having a personal laser printer within arm's reach. So even if you are looking for printers for a LAN environment, you may find the best solution here.

Our entries include 35 machines from Bézier Systems, Brother International Corp., C-Tech Electronics, Dataproducts Corp., Digital Equipment Corp., Eastman Kodak Co., Eicon Technology Corp., Epson America, Everex Systems, GCC Technologies, Hewlett-Packard Co., IBM Corp./Lexmark, LaserMaster Technologies Corp., Mannesmann Tally Corp., Microtek Lab, NEC Technologies, Okidata, Panasonic Communications & Systems Co., QMS, Sharp Electronics Corp., Star Micronics America, and Tandy Corp.

Though lower-end, single-user laser printers can be sorted into many kinds of categories, the simplest divisions (beyond price) are by the source of the laser engine, by the output speed, and by the page description language (PDL).

LITTLE ENGINES THAT CAN

Among the desktop laser printers we reviewed here, you will find engines from Canon USA, IBM Corp., Minolta Corp., Oki Electric, Panasonic Communications & Systems Co., Sharp Electronics Corp., and Tokyo Electronics Corp. (TEC). All of these engines produce good results, but engine speed varies considerably from company to company, as do the ease and economics of replacing such consumables as toner and photoconductive drums.

Speed counts, but don't ignore the convenience factor. Canon's original laser engine, which was the heart of the first, market-creating HP LaserJet printer back in 1984, introduced the idea of the single-use, all-in-one, disposable drum-and-toner combination. The ease and speed of simply pulling one print cartridge and replacing it with another are hard to beat. If you really do toss that cartridge after a single use, the per-page consumables price is a little high (about $0.03), not to mention the environmental costs of throwing a complicated, slow-to-break-down piece of plastic and metal into your local landfill. Several major players have launched recycling programs for cartridges; some offer a cash incentive, which may offset the higher per-page cost. (See the sidebar "New Lamps for Old: Are Recycled Cartridges Finally Worth Considering?") You may want to think twice about three-part photoconductor systems.

> *real-world print speed depends on more than just rated laser-engine speed.*

PPM: THEORY AND PRACTICE

If the combination of engine and toner system is one useful way to classify these printers, rated engine speed is another. Knowing the engine manufacturer is not enough. Canon, for example, produces the LX (4 pages per minute), SX (8 ppm) and RX (8 ppm, with duplexing and two paper-feed cassettes).

The engine-speed classes represented here are basically 4 to 6 ppm (18 printers), 8 ppm (12 printers), and above 8 ppm (6 printers). The workload you expect to throw at a printer will help you choose an engine speed, but things are not always what they seem, and real-world print speed depends on more than just rated laser-engine speed.

The printer-controller design—a circuit board embedded in the printer or less commonly installed in your PC and connected to the printer by a special video cable—determines how close your printer will come to its theoretical engine speed. Just because a printer is rated at 4 ppm does not always mean it delivers that speed: If the controller can't process incoming data fast enough, the printer is going to fall behind—perhaps far behind—that engine-speed rating. The nature of your work and the page description language in use also make a difference.

For straight text, good controllers come very close to supporting their associated engines's rated speed. But for pages with graphics on them—and especially for complicated graphics described for imaging by PostScript or one of the many PostScript clones—actual output won't come close to the rated engine speed.

This year has seen a big move by makers of even low-end lasers to juice up controller performance in an effort to bring real-world output results nearer to printer-engine specs. Primarily, this has been done by moving to controllers with RISC (Reduced Instruction Set Computing) chips from AMD, Intel Corp., or Weitek Corp. Of the 35 printers here, 10 have RISC processors; RISC is a particularly good fit for laser printer controllers, and the performance of many of these machines benefits substantially from their RISCed controllers.

Even in machines using Conventional Instruction Set Computing (or CISC) chips, the move is to higher clock-speed chips—away from 10-MHz and toward 16-MHz Motorola 68000s, for example—and often to more-recent and faster chips, such as the Motorola 68020.

PARLEZ-VOUS VECTORS?

Beyond engines, consumables, and controller speeds, you should look at the PDLs and the language emulations that these machines support. A PDL tells the printer where to place every one of the 8,000,000 or so dots on an 8.5- by 11-inch page with 300 by 300 dots per inch; to do this, it uses vector instructions and sometimes typeface outlines, as they build complicated bitmapped images.

Genuine Adobe PostScript is still king of the hill: It is precise, capable, and a widely supported industry standard, even if it is a bit slow. We now also have Adobe PostScript Level 2, a superset of the PostScript language introduced a year ago by Adobe and just now appearing in printers. Many of the improvements and extensions in PostScript Level 2 address issues not relevant to these printers (such as color support), so Level 2 capability may not be so important as some printer vendors would have you believe. Among the desktop laser printers we tested this year, only the Dataproducts LZR 960 boasts PostScript Level 2. (Two color PostScript printers, the Tektronix Phaser II PXi and

Bezier BP4040 — $1,895

4-ppm Canon LX engine-based laser printer with Microsoft TrueImage PostScript interpreter, HP PCL 4, and a RISC processor.

PCL TEXT SPEED	3.8 ppm
PS TEXT SPEED	3.9 ppm
ONE PAGE OUT	32 sec.
PCL GRAPHICS SPEED	1.5 gppm
PS GRAPHICS SPEED	0.6 gppm
PCL GRAPHICS TIME	0 min. 39 sec.
PS GRAPHICS TIME	1 min. 41 sec.

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Brother HL-4PS — $2,595

4-ppm Canon LX engine-based laser printer with Brother BR-Script PostScript interpreter and HP PCL 4.

PCL TEXT SPEED	3.9 ppm
PS TEXT SPEED	3.8 ppm
ONE PAGE OUT	32 sec.
PCL GRAPHICS SPEED	1.3 gppm
PS GRAPHICS SPEED	0.3 ppm
PCL GRAPHICS TIME	0 min. 46 sec.
PS GRAPHICS TIME	3 min. 26 sec.

Editor: a person employed
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Brother HL-8V — $2,495

8-ppm Canon SX engine-based laser printer with HP PCL 5.

PCL TEXT SPEED	7.6 ppm
ONE PAGE OUT	15 sec.
PCL GRAPHICS SPEED	2.8 gppm
PCL GRAPHICS TIME	0 min. 21 sec.

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Canon ProWriter CL-4 — $1,245

4-ppm TEC 1321C engine-based laser printer with HP PCL 4.

PCL TEXT SPEED	4.0 ppm
ONE PAGE OUT	31 sec.
PCL GRAPHICS SPEED	1.4 gppm
PCL GRAPHICS TIME	0 min. 43 sec.

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Dataproducts L2H 900 — $2,995

9-ppm Sharp JX-95 engine-based laser printer with Adobe PostScript Level 2, HP PCL 4, and a RISC processor.

PCL TEXT SPEED	7.9 ppm
PS TEXT SPEED	8.1 ppm
ONE PAGE OUT	20 sec.
PCL GRAPHICS SPEED	1.6 gppm
PS GRAPHICS SPEED	0.7 gppm
PCL GRAPHICS TIME	0 min. 38 sec.
PS GRAPHICS TIME	1 min. 26 sec.

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DECLaser 1150 — $3,049

4-ppm Canon LX engine-based laser printer with Adobe PostScript and HP PCL 4.

PCL TEXT SPEED 3.9 ppm
PS TEXT SPEED 3.8 ppm
ONE PAGE OUT 35 sec
PCL GRAPHICS SPEED 0.8 gppm
PS GRAPHICS SPEED 0.4 gppm
PCL GRAPHICS TIME 1 min. 17 sec.
PS GRAPHICS TIME 2 min. 22 sec.

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DECLaser 2150 — $3,499

8-ppm Canon SX engine-based laser printer with Adobe PostScript.

PS TEXT SPEED 7.4 ppm
ONE PAGE OUT 20 sec.
PS GRAPHICS SPEED 0.5 gppm
PS GRAPHICS TIME 2 min. 6 sec.

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DECLaser 2250 — $5,149

8-ppm Canon RX engine-based laser printer with Adobe PostScript and duplex printing.

PS TEXT SPEED: 7.4 ppm
ONE PAGE OUT 23 sec.
PS GRAPHICS SPEED: 0.5 gppm
PS GRAPHICS TIME. 2 min. 7 sec.

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Palatino **Bold** Underline

Eastman Kodak Ektaplus 7000 — $1,395

8-ppm TEC 1306C engine-based laser printer with HP PCL 4. No PostScript option available at press time.

PCL TEXT SPEED. 7.4 ppm
ONE PAGE OUT 21 sec.
PCL GRAPHICS SPEED: 1.7 gppm
PCL GRAPHICS TIME: 0 min. 36 sec.

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Line Printer Bold Underline Co

EiconLaser — $5,595

8-ppm Canon SX engine-based laser printer with EiconScript PostScript interpreter, a RISC processor, and 800- by 400-dpi output.

PS TEXT SPEED: 7.3 ppm
PS GRAPHICS SPEED: N/A
ONE PAGE OUT: 19 sec.

Unable To Run Graphics Test Unassisted

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Unable To Run Graphics Test Unassisted

Which PC Is Your Only Logical Choice?

GATEW

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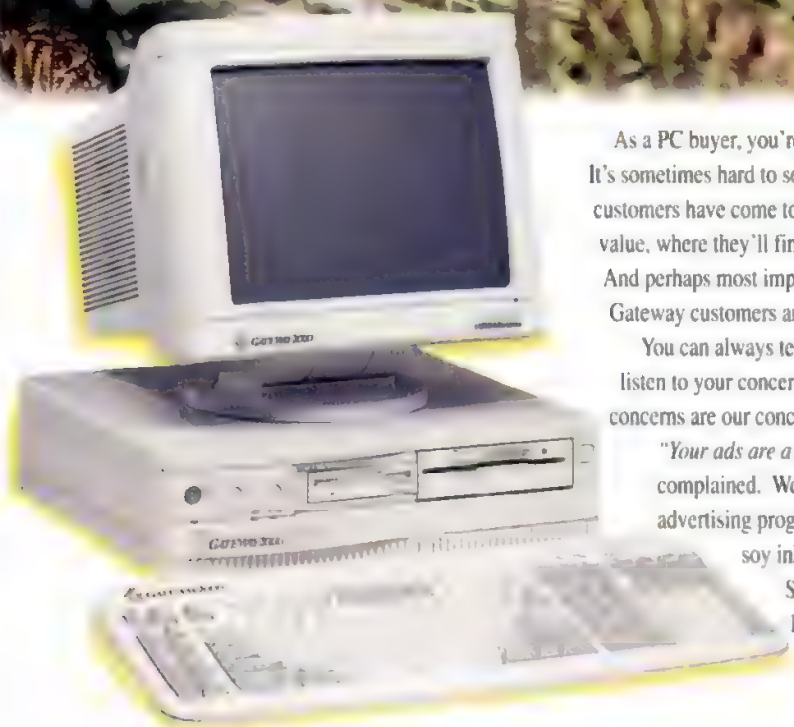

As a PC buyer, you're constantly confronted with wild claims and overgrown prices. It's sometimes hard to see the forest for the trees in the PC jungle. But Gateway 2000 customers have come to know they can trust us. They know Gateway is a sanctuary of value, where they'll find the best prices on quality systems backed by excellent service. And perhaps most importantly, they know we'll treat them as the special friends all Gateway customers are.

You can always tell if a company truly values its customers by the way its people listen to your concerns and how the company responds. At Gateway, your concerns are our concerns. For example:

"Your ads are a waste of precious natural resources," more than a few customers complained. We listened. And we're responding by using recycled paper in our advertising program. You'll also see us switching from petroleum-based inks to soy inks in our printing soon.

Several customers thought we should down-size our ads to spend less on advertising and to use less paper. From a business standpoint, we didn't want to do that because the ad you're reading is our only store. And we've never exceeded our ad budget, which is a tiny percentage of sales. But we aren't ignoring these customers' concerns. Even though the paper

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JUNGLE OUT THERE

companies we deal with have excellent reforestation programs, we became a Global Releaf® corporate sponsor. The money we contribute to this American Forestry Association project will plant over 15,000 new trees in the next 12 months.

In the PC jungle, Gateway 2000 is a sanctuary of value, where your concerns are our concerns.

Susan Gerbeth-Jones
Duke University

It's literally a jungle out there at the Organization for Tropical Studies (OTS), a consortium of 52 prestigious universities and research institutions. OTS uses Gateway 2000 systems in Costa Rica to do research in tropical rain forests. Don Stone, OTS's Executive Director, decided to put Gateway computers in the jungle after confirming their great value and reliability with Susan Gerbeth-Jones, Data Processing Specialist at Duke University, one of OTS's member institutions. Don asked Susan if she had ever heard of a company called Gateway 2000, to which she replied, "Why, yes I have – here's one right here." Susan said she's had her Gateway at Duke for over a year. "Everything about it is solid and it runs smoother than any other computer in the department," she commented. "I feel Gateway 2000 has more features for the money."

recycled paper

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GATEW

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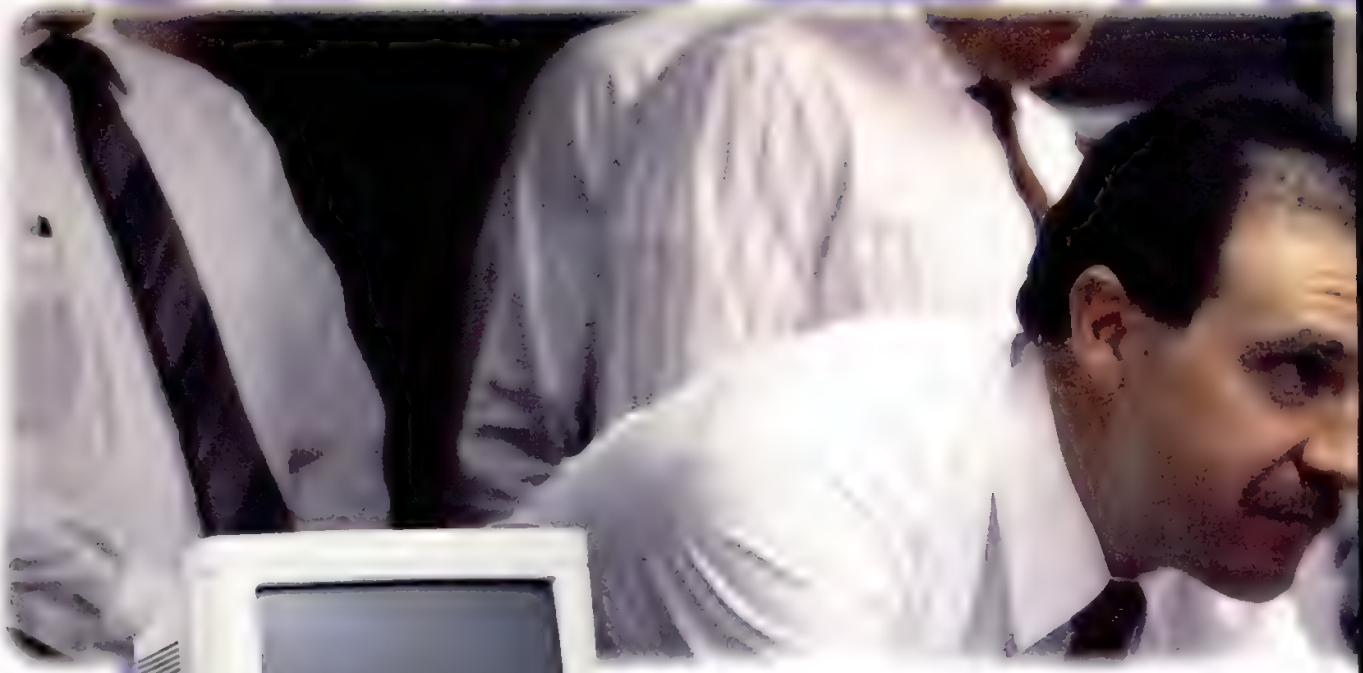


Gateway 2000 has stood the test of time. *PC Week* includes Gateway 2000 in a very short list of successful computer makers. "The common themes: high-value, low-cost products. Close contact with customers. *And sincerity over time.* Buyers value vendors that have priced their products fairly from the outset, not just in reaction to dwindling market share and impractical cost structures."

We know you also value a vendor's stability over time. A dentist from Watertown, South Dakota, wrote to us recently for assurance that his Gateway computer won't become an "orphan" someday. Nobody wants to buy a PC today and find out tomorrow the manufacturer went out of business.

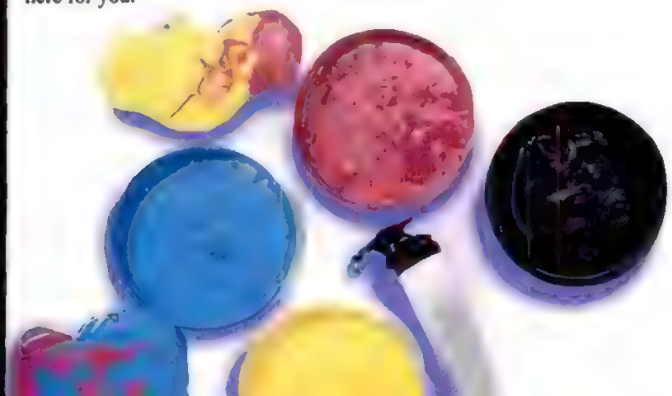
When you buy a Gateway 2000 computer, you can be assured that you're doing business with one of the largest and most successful PC direct marketers in the nation. In the July 1 issue of *Business Week* magazine, Gateway is ranked as the third largest direct market computer manufacturer in the nation based on 1990 revenues of $275 million. In just two quarters of 1991, we've nearly exceeded 1990 revenues. Many

AY2000

THE TEST OF TIME

companies would envy our June 30 balance sheet, which shows current assets outweighing current liabilities by more than 2 to 1 and our equity being more than 10 times our long-term debt.

What that means is your computer won't become an orphan; we'll be here to honor your 30-day money-back guarantee and one-year warranty on parts and labor; we'll be here to provide lifetime telephone technical support and bulletin board services; and we'll grow with you, bringing you the best value in the highest technology computer products for years to come. Gateway 2000 – we've stood the test of time. We're going to be here for you.



Andy Rifkin
Time Customer Service

Gateway 2000 has stood the rigorous tests of Time Customer Service in Tampa, Florida. TCS now has over 250 Gateway systems in use. Some of the Gateways are used in mission critical business applications such as Target Select. Target Select is a process whereby a magazine is built and customized with inkjet printing at bindery time. But TCS's Andy Rifkin, Director of Advanced Technologies, didn't buy all those Gateways without careful consideration.

"We use Gateways in mission-critical applications," said Andy. "If the systems running our application go down, we're out of business. That's why we do extensive testing before we buy. We have at least one PC from every computer company ever in existence," he continued. "These systems have all been through our testing process, but the Gateways have unquestionably been our top-performing PC's with a failure rate less than 2%."

Andy said initially it was risky for him to recommend Gateway 2000 over the more traditional corporate computer suppliers. "But Gateway came through for Time Customer Service, at a fraction of what we had been paying for PC's."

GATEW

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Tower Optional.

Gateway 2000's tireless efforts to bring you the best value have resulted in unbeatable features, performance, and prices.

Gateway was one of the first companies to make a non-interlaced color monitor standard with 386DX and 486 systems. No increase in price.

Other custom keyboards pale compared to Gateway's 124-key programmable AnyKey™. And unlike other custom keyboards, the AnyKey is standard with all Gateway 2000 systems. No increase in price.

Gateway 2000 was one of the first companies to break the $4,000 barrier in 486 system prices. Now our 486 models are selling for prices you'd expect to pay for 386 systems. While some companies are promoting 486SX models as the affordable 486, Gateway is offering you a true 486 at a better price.

On all SX and DX systems, a Microsoft® mouse and Windows™ 3.0 are standard. MS DOS® 5.0 comes standard will all systems. With Gateway, you don't pay extra for the tools you need to get the most out of your computer.

Gateway customers told us they liked the price and performance of their systems, but they weren't crazy about the "plain vanilla" looks of Gateway computers. So we introduced an entirely redesigned product line with unique, contemporary-looking systems. No increase in price.

Our customers told us they wanted a small footprint model with room for expansion. So we introduced a space-saving mini desktop model for 286 and 386SX systems with five 16-bit slots open in the standard configuration.

Customers are telling us they want a Gateway 2000 notebook. The best is yet to come.

AY2000

EFFORTS TO GIVE YOU THE BEST VALUE

We're tireless in our efforts to offer you the best value in the industry because we're on a mission. Our mission is to make Gateway 2000 the only logical choice in microcomputers. To achieve this ambitious goal, we must continue giving you what you want: great prices on quality, high-performance products, backed by excellent support policies and our award-winning technical service people. With Gateway, you can have it all. In the race for leadership in the computer industry, the real winner is you!

Gateway 2000's tireless efforts to offer the best value in the industry convinced the world-famous Pirelli® Armstrong Tire Corporation to buy Gateway computers. "They never raise their prices," said Gary Boyd, Controller for Pirelli, from his office in Hanford, California. "Gateway is continually improving the quality of their products and services, and yet their prices keep going down."

Pirelli uses Gateway systems in every department. "The engineers in particular love them," Gary commented. "They run Gateway 486 systems as CAD workstations to design products, equipment and plant facilities."

Pirelli people are taking Gateway systems home with them, too. Last year the company hosted a computer fair to give employees a chance to compare various computer brands on the market. "Our factory manager bought a Gateway for home, as did the manufacturing manager, four of the engineers and myself, just to name a few," said Gary. "Even with all the competition at the fair, Gateway 2000 clearly offered the best value."

Gary Boyd
Pirelli Armstrong Tire Corporation

GATEWAY 2000

16MHZ 286

- 80286 Processor
- 2 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 40 MB 17ms IDE Drive with 32K Cache
- 16-Bit VGA with 512K
- 14" Crystal Scan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 1 PS/2 Mouse Port
- 124-Key AnyKey™ Keyboard
- MS DOS® 5.0

$1345

16MHZ 386SX

- Intel® 80386SX Processor
- 2 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 40 MB 17ms IDE Drive with 32K Cache
- 16-Bit VGA with 512K
- 14" Crystal Scan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 1 PS/2 Mouse Port
- 124-Key AnyKey Keyboard
- Microsoft® Mouse
- MS DOS 5.0
- MS Windows™ 3.0

$1495

20MHZ 386SX

- Intel 80386SX Processor
- 32K Cache RAM
- 4 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 80 MB 17ms IDE Drive with 32K Cache
- 16-Bit VGA with 512K
- 14" Crystal Scan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 1 PS/2 Mouse Port
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0

$1795

25MHZ 386

- Intel 80386 Processor
- 4 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 80 MB 17ms IDE Drive with 32K Cache
- 16-Bit VGA with 1 MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0

$1995

BEST BUYS

- Get our 33 MHz 386 system, same configuration as listed, with a 120 MB IDE hard drive instead of the 200 MB drive.

$2245

- Same features as our 33 MHz 486 system except this machine has 4 MB RAM, instead of 8, and a 120 MB IDE hard drive, instead of the 200 MB drive in our standard configuration.

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33MHZ 386

- Intel 80386 Processor
- 64K Cache RAM
- 4 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 200 MB 15ms IDE Drive with 64K Multi-Segmented Cache
- 16-Bit VGA with 1 MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0

$2495

33MHZ 486

- Intel 80486 Processor
- 64K Cache RAM
- 8 MB RAM, Expands to 64MB
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 200 MB 15ms IDE Drive with 64K Multi-Segmented Cache
- 16-Bit VGA with 1 MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0

$2995

33MHZ 486 EISA

- Intel 80486 Processor
- 128K Cache RAM
- 8 MB RAM, Expands to 64 MB
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 340 MB 15ms SCSI Drive with 128K Multi-Segmented Cache
- 32-Bit EISA SCSI Controller
- 16-Bit VGA with 1 MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0

$3895

The Extras – That Don't Cost Extra At Gateway

- One-year warranty on parts and labor
- Replacement parts shipped quickly via overnight shipping at no charge
- 30-day money-back guarantee
- Lifetime toll-free technical support from the service organization that won PC World's Service Excellence Award
- Free on-site service to most locations
- Free bulletin board technical support
- C.O.D. terms and major credit cards honored
- Net 30-day credit terms available to qualified commercial customers
- Leasing options available to qualified commercial customers
- MS DOS 5.0 is standard; versions 4.01 and 3.3 are available at no extra charge
- The programmable AnyKey keyboard is standard; a 101-key keyboard is also available at no extra charge

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intel inside

GATEWAY 2000

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You'd Read This And Weep

Introducing Gateway 2000's 33 MHz 486 EISA For $3895

And you thought the "E" in EISA stood for expensive! At $3,895, Gateway's 486-33 EISA system is priced lower than most 486-33 ISA systems. Now you can take advantage of Extended Industry Standard Architecture, capable of running the latest technology 32-bit boards, at an affordable price.

Includes 32-Bit EISA SCSI Controller

Gateway's price is especially remarkable when you consider that this EISA system comes with a 32-bit EISA SCSI controller – an expensive option with most other manufacturers' EISA computers. The EISA SCSI controller makes disk operations lightning fast. Other SCSI options are also available.

Ideal For Disk-Intensive Applications

The 486-33 EISA is ideal for use as a file server and for high-end CAD, workstation, and network applications. It's also the best computer on the market if you want the security of knowing you've planned well for the future.

Crystal Scan 1024NI Standard

The EISA system includes Gateway's non-interlaced Crystal Scan monitor, designed for flicker-free video display. The Crystal Scan 1024NI has a 14-inch non-glare tube, 0.28mm dot pitch with 1024 x 768 resolution at 60 Hz, 800 x 600 at 72 Hz.

AnyKey™ Keyboard Standard

Our custom 124-key keyboard is called the AnyKey because any key can be programmed to perform any function or series of keystrokes. The entire keyboard can be remapped to create your own keyboard layout. The AnyKey's versatility is rivaled only by its simplicity. You can learn to program it in just a few minutes. And if you hate the idea of programming anything, you'll still love the feel and extra keys on the AnyKey.

Just Add Your Favorite Programs

All Gateway systems arrive ready to run. The hard drive is formatted and the software that comes with each system is loaded. All you have to do is install your favorite applications. Software diskettes and comprehensive hardware and software manuals are included.

Components and peripherals are sold separately only to Gateway 2000 customers.

GATEWAY2000

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Epson EPL-7000 — $1,399

6-ppm Minolta SP101 engine-based laser printer with HP PCL 4. No PostScript option available at press time.

PCL TEXT SPEED	5.7 ppm
ONE PAGE OUT	25 sec.
PCL GRAPHICS SPEED	1.5 gppm
PCL GRAPHICS TIME	0 min. 38 sec.

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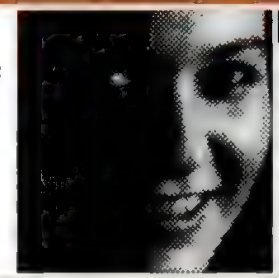
Line Printer Bold Underline C

Epson EPL-7500 — $2,999

6-ppm Minolta SP101 engine-based laser printer with Adobe PostScript, HP PCL 4, and a RISC processor.

PCL TEXT SPEED	5.9 ppm
PS TEXT SPEED	5.9 ppm
ONE PAGE OUT	22 sec.
PCL GRAPHICS SPEED	1.4 gppm
PS GRAPHICS SPEED	0.6 gppm
PCL GRAPHICS TIME	0 min. 42 sec.
PS GRAPHICS TIME	1 min. 36 sec.



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Everex LaserScript LX — $1,995

6-ppm TEC 1305Z engine-based laser printer with Microsoft Interpreter PostScript emulator and HP PCL 4.

PCL TEXT SPEED	5.7 ppm
PS TEXT SPEED	6.0 ppm
ONE PAGE OUT	25 sec.
PCL GRAPHICS SPEED	1.6 gppm
PS GRAPHICS SPEED	0.4 gppm
PCL GRAPHICS TIME	0 min. 37 sec.
PS GRAPHICS TIME	2 min. 17 sec.

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GCC BLP II — $1,999

4-ppm Oki Electric OL-400 engine-based LED printer with Adobe PostScript.

PS TEXT SPEED	4.2 ppm
ONE PAGE OUT	27 sec.
PS GRAPHICS SPEED	0.7 gppm
PS GRAPHICS TIME	1 min. 31 sec.

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GCC BLP IIS — $2,699

8-ppm Oki Electric OL-800 engine-based LED printer with Adobe PostScript.

PS TEXT SPEED	7.9 ppm
ONE PAGE OUT	15 sec.
PS GRAPHICS SPEED	0.8 gppm
PS GRAPHICS TIME	1 min. 18 sec.

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HP LaserJet IIP — $1,595

4-ppm Canon LX engine-based laser printer with HP PCL 4.

PCL TEXT SPEED	4.0 ppm
ONE PAGE OUT	33 sec.
PCL GRAPHICS SPEED	1.6 gppm
PCL GRAPHICS TIME	0 min. 38 sec.

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IBM LaserPrinter 5e — $1,595

5-ppm IBM engine-based laser printer with HP PCL 4.

PCL TEXT SPEED	4.5 ppm
ONE PAGE OUT	18 sec.
PCL GRAPHICS SPEED	2.4 gppm
PCL GRAPHICS TIME	0 min. 24 sec.

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IBM LaserPrinter 6 — $1,895

6-ppm IBM engine-based laser printer with HP PCL 4. $499 Adobe PostScript option and $799 4MB RAM upgrade needed for 600- by 600-dpi output.

PCL TEXT SPEED	5.7 ppm
ONE PAGE OUT	19 sec.
PCL GRAPHICS SPEED	2.3 gppm
PCL GRAPHICS TIME	0 min. 25 sec.

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IBM LaserPrinter 10 — $2,395

10-ppm IBM engine-based laser printer with HP PCL 4. $499 Adobe PostScript option and $799 4MB RAM upgrade needed for 600- by 600-dpi output.

PCL TEXT SPEED	9.1 ppm
ONE PAGE OUT	18 sec.
PCL GRAPHICS SPEED	2.6 gppm
PCL GRAPHICS TIME	0 min. 22 sec.

Editor: a person e
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LaserMaster TrueTech 800/4 — $3,695

4-ppm Canon LX engine-based laser printer with Microsoft TrueImage PostScript interpreter, a RISC processor, and 800- by 800-dpi output.

PS TEXT SPEED	3.7 ppm
ONE PAGE OUT	30 sec.
PS GRAPHICS SPEED	0.8 gppm
PS GRAPHICS TIME	1 min. 10 sec.

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LaserMaster TrueTech 1000 — $6,995

8-ppm Canon SX engine-based laser printer with Microsoft TrueImage PostScript interpreter, a RISC processor, and 1,000- by 1,000-dpi output.

PS TEXT SPEED	7.2 ppm
ONE PAGE OUT	19 sec.
PS GRAPHICS SPEED	0.9 gppm
PS GRAPHICS TIME	1 min. 5 sec.

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Mannesmann Tally MT735 — $1,295

6-ppm Mannesmann Tally 735 engine-based portable thermal wax transfer printer with HP PCL 4. No PostScript option available at press time.

PCL TEXT SPEED	6.3 ppm
ONE PAGE OUT	11 sec.
PCL GRAPHICS SPEED	1.4 gppm
PCL GRAPHICS TIME	0 min. 42 sec.

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Mannesmann Tally MT911 PS — $3,195

10-ppm Konica LP3110 engine-based laser printer with Microsoft Interpreter PostScript interpreter and HP PCL 4.

PCL TEXT SPEED	9.0 ppm
PS TEXT SPEED	8.9 ppm
ONE PAGE OUT	17 sec.
PCL GRAPHICS SPEED	2.4 gppm
PS GRAPHICS SPEED	0.3 gppm
PCL GRAPHICS TIME	0 min. 25 sec.
PS GRAPHICS TIME	2 min. 56 sec.

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Microtek TrueLaser — $2,695

6-ppm TEC 1305Z engine-based laser printer with Microsoft TrueImage PostScript emulator, HP PCL 4, and a RISC processor.

PCL TEXT SPEED	5.8 ppm
PS TEXT SPEED	6.1 ppm
ONE PAGE OUT	24 sec.
PCL GRAPHICS SPEED	1.8 gppm
PS GRAPHICS SPEED	1.0 gppm
PCL GRAPHICS TIME	0 min. 33 sec.
PS GRAPHICS TIME	1 min. 1 sec.

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NEC SilentWriter2 990 — $4,495

8-ppm Canon LBBP-UX engine-based laser printer with Adobe PostScript, HP PCL 4, and a RISC processor.

PCL TEXT SPEED	7.4 ppm
PS TEXT SPEED	7.5 ppm
ONE PAGE OUT	19 sec.
PCL GRAPHICS SPEED	1.6 gppm
PS GRAPHICS SPEED	0.7 gppm
PCL GRAPHICS TIME	0 min. 37 sec.
PS GRAPHICS TIME	1 min. 28 sec.

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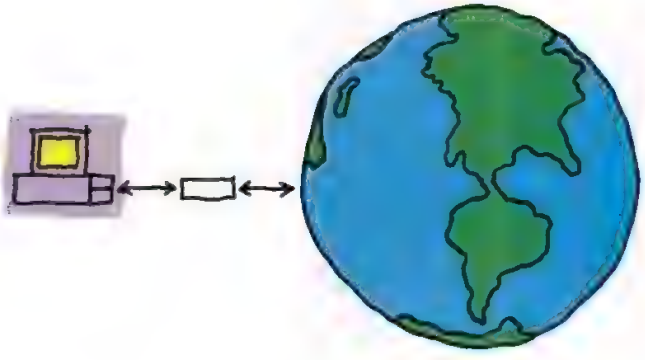

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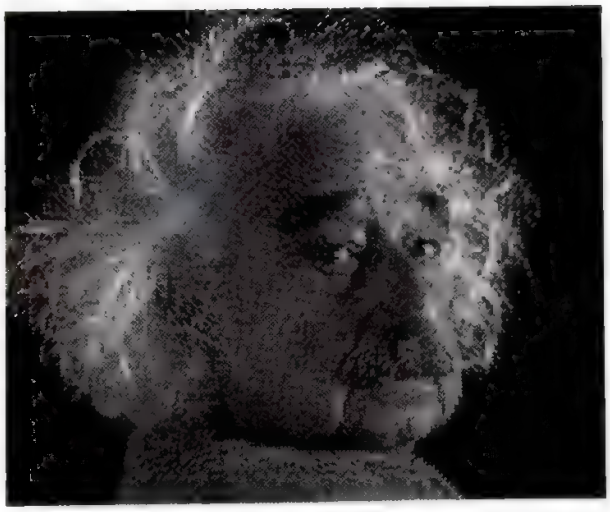
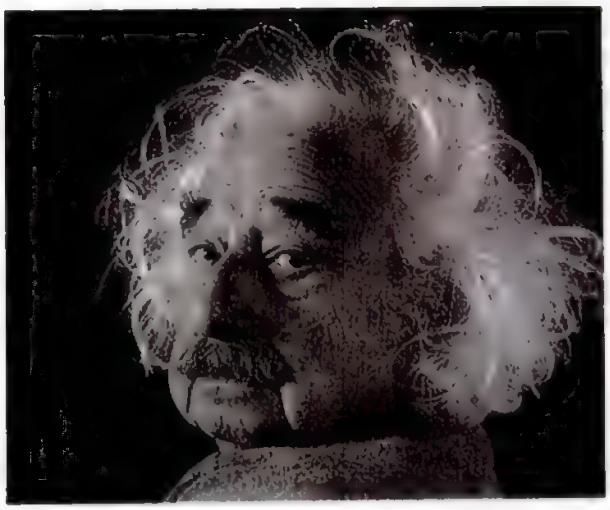


Actual standard laser printer output in 64 shades.



Actual AcerLaser IIIG output in 64 shades.

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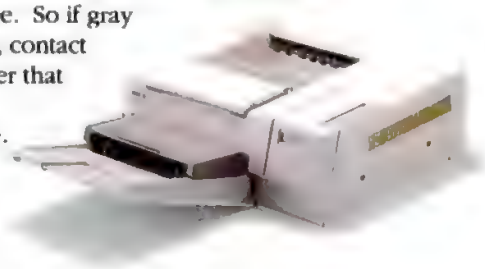
Add 78 resident fonts, a high-speed processor and 6 page per minute print speed, HP compatibility, a 6000 page all-in-one imaging cartridge that lasts almost twice as long as most printers, and a 250 sheet universal paper tray. The AcerLaser IIIG — no other printer offers so much to desktop publishing/presentation, and word processing at such an affordable price. So if gray matters to you, contact the smart dealer that offers the AcerLaser IIIG. It's a wise decision.



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Oxidata OL850 — $1,999

8-ppm Oki Electric OL800 engine-based LED printer with Adobe PostScript and HP PCL 4.

PCL TEXT SPEED	8.1 ppm
PS TEXT SPEED	7.9 ppm
ONE PAGE OUT	15 sec.
PCL GRAPHICS SPEED	3.1 gppm
PS GRAPHICS SPEED	0.9 gppm
PCL GRAPHICS TIME	0 min. 19 sec.
PS GRAPHICS TIME	1 min. 10 sec.

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Panasonic KX-P4455 Laser Partner — $2,995

11-ppm Panasonic engine-based laser printer with Adobe PostScript and HP PCL 4.

PCL TEXT SPEED	8.6 ppm
PS TEXT SPEED	10.2 ppm
ONE PAGE OUT	20 sec.
PCL GRAPHICS SPEED	1.4 gppm
PS GRAPHICS SPEED	0.8 gppm
PCL GRAPHICS TIME	0 min. 44 sec.
PS GRAPHICS TIME	1 min. 16 sec.

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QMS PS-815 — $4,995

8-ppm Canon SX engine-based laser printer with Adobe PostScript and HP PCL 4.

PCL TEXT SPEED	7.4 ppm
PS TEXT SPEED	7.5 ppm
ONE PAGE OUT	19 sec.
PCL GRAPHICS SPEED	1.9 gppm
PS GRAPHICS SPEED	0.7 gppm
PCL GRAPHICS TIME	0 min. 32 sec.
PS GRAPHICS TIME	1 min. 27 sec.

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QMS PS-815 MR — $5,495

8-ppm Canon SX engine-based laser printer with Adobe PostScript and HP PCL 4.

PCL TEXT SPEED	7.2 ppm
PS TEXT SPEED	7.3 ppm
ONE PAGE OUT	20 sec.
PCL GRAPHICS SPEED	1.8 gppm
PS GRAPHICS SPEED	0.7 gppm
PCL GRAPHICS TIME	0 min. 34 sec.
PS GRAPHICS TIME	1 min. 29 sec.

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QMS PS-825 — $5,995

8-ppm Canon TX engine-based laser printer with Adobe PostScript and HP PCL 4.

PCL TEXT SPEED	7.2 ppm
PS TEXT SPEED	7.4 ppm
ONE PAGE OUT	22 sec.
PCL GRAPHICS SPEED	1.4 gppm
PS GRAPHICS SPEED	0.7 gppm
PCL GRAPHICS TIME	0 min. 43 sec.
PS GRAPHICS TIME	1 min. 31 sec.

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Sharp JX-9500H — $1,599

9-ppm Sharp JX-95 engine-based laser printer with HP PCL 4. No PostScript option available at press time.

PCL TEXT SPEED	8.5 ppm
ONE PAGE OUT	17 sec.
PCL GRAPHICS SPEED	1.4 gppm
PCL GRAPHICS TIME	0 min. 43 sec.

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Sharp JX-9500PS — $2,849

6-ppm Sharp JX-95 engine-based laser printer with Adobe PostScript and HP PCL 4.

PCL TEXT SPEED	6.5 ppm
PS TEXT SPEED	6.5 ppm
ONE PAGE OUT	17 sec.
PCL GRAPHICS SPEED	2.0 gppm
PS GRAPHICS SPEED	0.6 gppm
PCL GRAPHICS TIME	0 min. 29 sec
PS GRAPHICS TIME	1 min. 41 sec.

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Star Micronics LaserPrinter 4 — $1,395

4-ppm Canon LX engine-based laser printer with HP PCL 4 and a RISC processor.

PCL TEXT SPEED	4.0 ppm
ONE PAGE OUT	32 sec.
PCL GRAPHICS SPEED	1.5 gppm
PCL GRAPHICS TIME	0 min. 41 sec.

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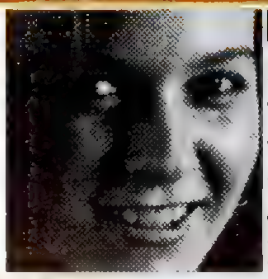
Star Micronics LaserPrinter 4 StarScript — $1,995

4-ppm Canon LX engine-based laser printer with Star Micronics StarScript PostScript interpreter, HP PCL 4, and a RISC processor.

PCL TEXT SPEED	4.0 ppm
PS TEXT SPEED	4.0 ppm
ONE PAGE OUT	32
PCL GRAPHICS SPEED	1.5 gppm
PS GRAPHICS SPEED	0.6 gppm
PCL GRAPHICS TIME	0 min. 39 sec.
PS GRAPHICS TIME	1 min. 40 sec.



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Tandy LP 950 — $1,599

6-ppm Sharp JX-95 engine-based laser printer with HP PCL 4. No PostScript option available at press time.

PCL TEXT SPEED	6.2 ppm
ONE PAGE OUT	18 sec.
PCL GRAPHICS SPEED	1.3 gppm
PCL GRAPHICS TIME	0 min. 48 sec.

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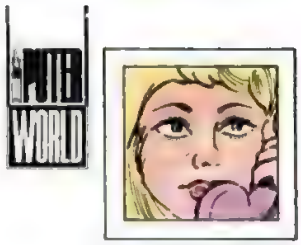

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- 1 Meg SVGA Card 1024 x 768 w/ SIERRA DAK Chip (1 Meg for 256 Colors at 1024 x 768) (1 Meg for 32,768 colors at 800 x 600)
- 101 Keyboard
- MS Windows 3.0 w/Logitech, 3 Button, 400 DPI Mouse
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Tektronix Phaser III PXi, also have PostScript Level 2.) Because the printer driver is so important in determining a printer's actual (not engine) speed, Adobe has taken upon itself the task of producing PostScript Level 2 drivers for *Microsoft Windows*. Look for them early in 1992, along with a slew of new printer introductions. Some vendors have printers ready to go; these products are sitting in warehouses, awaiting the new driver.

Another PDL issue is whether a printer supports Level 4 or Level 5 of Hewlett-Packard Co.'s Printer Control Language (HP PCL). HP PCL 5 appeared with the trend-setting LaserJet III and LaserJet IIID last year (along with HP's remarkable Resolution Enhancement Technology, which modulates dot size and dot position to make 300-dpi resolution output look like higher-resolution output).

PCL 5 is not easy to clone, and among these printers, only the Brother HL-8V and the HP LaserJet IIIP come standard with a PCL 5 emulation. You can also get PCL 5 as an option on the IBM LaserPrinter 10.

This may not matter much to you, though: Few software packages support PCL 5, even in their latest incarnations. That's a shame, because PCL 5 offers font scaling from high-quality outlines and fast, accurate vector manipulation for line-drawing and fills. Software Publishing Corp.'s *Harvard Graphics* and Lotus Development Corp.'s *Freelance Professional* use PCL 5, and *WordPerfect* 5.1 fools with it a little. That's about it. Neither *Windows* 3.0 nor the upcoming *Windows* 3.1 has complete PCL 5 support, although they do allow font scaling. If and when *Windows* gets a complete PCL 5 driver, you will be able to scale an oversize *Microsoft Excel* spreadsheet to fit on one page, or print a half-dozen *PageMaker* thumbnail pages on a single page, just as PostScript printers can do today.

Microsoft TrueImage, a PostScript interpreter, looked as if it might be a contender in the PDL wars, too. The makers of four printers reviewed here, which are based on TrueImage, want you to believe it still is. Developed by a Microsoft team led by Cal Bauer, TrueImage is the PDL counterpart of TrueType, the Apple/Microsoft type-outline technology, which is available in Apple's System 7 for the Mac and is due shortly in *Windows* 3.1.

Even so, TrueImage faded almost as fast as the hype cooked up for it. Bauer has left Microsoft, and the company has dealt off TrueImage (and its TrueImage licensees) to LaserMaster, which will continue, in theory, to help develop TrueImage products. TrueType itself will still appear in *Windows* 3.1, but the strength of Adobe's PostScript Type 1 font-outline standard, customers' huge investment in that standard, and continuing improvements in the *Adobe Type Manager* on-screen font renderer for *Windows* all augur poorly for much of a future for TrueType.

THE REAL-ESTATE GAME

There is one last factor you should consider when evaluating these printers: their footprints.

Some desktop laser printers are now so small they take up just over 1 square foot. This is a godsend for those who work in cubicles and for those buying a printer for a home office. It may also be an issue when you're trying to hide a printer in the boss's overdecorated office.

The chassis of the Sharp JX-9500H and Sharp JX-9500PS are especially commendable: They measure 13 by 14 inches and are only about a foot high. Even better, unlike some other printers that have feed and output trays protruding several inches, these two printers have trays that tuck inside and under the machine, so you don't need to add a fudge factor for trays (and tray removal) to that 13- by 14-inch footprint.

IN THE END, PRICE ALWAYS COUNTS

We still don't have sub-$500 desktop laser printers or sub-$1,000 PostScript laser printers, but we may by this time next year. This year's economy champs include the $900 Star Micronics LaserPrinter 4, the $1,200 PostScript-clone Star Micronics LaserPrinter4 StarScript, and especially for high-speed text-only work, the under-$1,000 8.5-ppm Sharp JX-9500H. HP introduced the upgraded LaserJet IIP Plus in October, too late to be reviewed. It has a $1,249 list price ($46 less than the now-discontinued LaserJet IIP), PCL 4, a faster processor than the LaserJet IIP, and the ability to upgrade via cartridges to PCL 5 or PostScript. It should have a street price under $900.

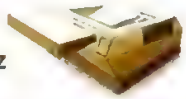
Moving up the price scale a little, it is hard to beat HP's LaserJet IIIP (reviewed here), typically under $1,100 on the street. Add HP's genuine Adobe PostScript cartridge and 1MB of memory (typically $500 to $600) and you have a snug, very compact, superbly built PostScript machine.

The individual reviews of these 35 machines and the Editors' Choice box offer more advice. The simple answer: Today, there are a lot of good, affordable choices near the bottom of the desktop-laser printer market.

It may not be hard to go wrong, but it's easy to go right.

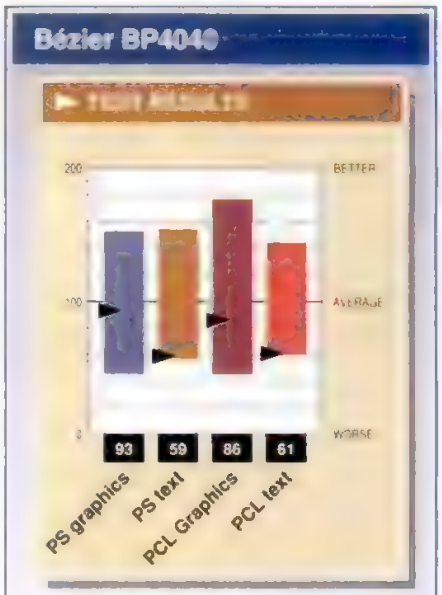
BÉZIER SYSTEMS INC.

Bézier BP4040



by Wendy Dugas Pérez

Year-old Bézier Systems' first laser printer, the 4-page-per-minute Bézier BP4040, has promise. Based on the same Canon LX engine used in the HP LaserJet IIP and LaserJet IIIP, the BP4040 comes with PostScript compatibility (the Microsoft TrueImage interpreter) and support for HP PCL 4. Its controller has the AMD 29000 RISC processor on-board, which gives a performance edge. And the BP4040 is priced aggressively: At a list price of $1,895, it is one of only five PostScript-



PCL and PostScript scores

In Short: With PostScript compatibility (Microsoft TrueImage), support for HP PCL 4, and an AMD 29000 RISC processor that delivers solid performance, the Canon LX–based 4-ppm $1,895 Bézier BP4040 looks promising. But a sparse control panel, incomplete documentation, and the lack of a slot for font cartridges or cards temper our enthusiasm.

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CIRCLE 357 ON READER SERVICE CARD

EDITORS' CHOICE

- **HP LaserJet IIIP (personal laser printer)**
- **IBM LaserPrinter 10 (mainstream laser printer, high-quality PostScript printer)**
- **Okidata OL830 (inexpensive PostScript printer)**

Laser printers get better and cheaper each year. This year, PC Magazine Labs tested 45 page printers that use laser, LCD, and LED technologies. The reviews for 10 of these are in a separate shared-printer section for network-designed printers that can print 10 or more pages per minute. Of the 35 mainstream desktop laser printers rated at 4 to 10 ppm, the majority offer scalable fonts and quiet, high-quality output. Three stand above the rest and earn an Editors' Choice: the affordable 4-ppm HP LaserJet IIIP; the mainstream 10-ppm IBM LaserPrinter 10, with its superb PostScript option; and the PostScript-standard 8-ppm Okidata OL830.

The best laser printer we saw in the past was the HP LaserJet III, an Editors' Choice last year and available for about $1,500 now. With font scaling and Resolution Enhancement Technology (RET), the LaserJet III remains the best choice. But advances in other printers reveal a few shortcomings: It is clumsy switching between HP PCL 5 and the optional PostScript interpreter; not everyone likes the aesthetics of the built-in Helvetica-style and Times Roman–style typefaces, and few programs take full advantage of PCL 5's line-draw and area-fill capabilities.

600 DPI FROM IBM

The $2,395 IBM LaserPrinter 10 equals the LaserJet III on most counts, including list price, and moves ahead on others: resolution, speed, and paper handling. Most impressive is the 600-dot-per-inch resolution you get with the Adobe PostScript option ($499 to $898, depending on the accompanying fonts) and 4MB of RAM ($799). This is true 600-dpi output—no marketing doublespeak or technical gimmickry. The base-priced printer has PCL 4 and Print Quality Enhancement Technology (PQET), IBM's variant of RET, and for $199 you can upgrade this model to handle PCL 5. In HP-compatible mode, the LaserPrinter 10 runs at 9.1 ppm, compared with the LaserJet III's 7.4 ppm; that's the fastest of this year's desktop PCL printers. Using the optional PostScript cartridge in 300-dpi mode, it delivered the fastest PostScript graphics output we've ever seen from a desktop laser printer. And it bristles with paper-handling options: an additional bottom cassette holding 500 sheets, an auxiliary 100-sheet cassette, and an envelope cassette. You can buy a 6-ppm version, the LaserPrinter 6, for $1,895 ($500 less) and later upgrade it to LaserPrinter 10 specs (for $899 more). It accepts the same PostScript option and produces the same speedy graphics output.

A note on IBM nomenclature: The full name of our winner is the IBM Model 4029-030 LaserPrinter 10. Some dealers may call it the Model 30. Don't confuse it with the $1,595 IBM Model 4029-010 LaserPrinter 5e, which dealers may call the Model 10. This printer is a good one, but you cannot upgrade it as you can the LaserPrinter 6.

BEST AFFORDABLE POSTSCRIPT PRINTER: OKIDATA

If the IBM LaserPrinter 10 is the best PostScript printer overall, the Okidata OL830 is the best PostScript printer for cost-conscious buyers: It was the only 8-ppm PostScript-compatible printer with a list price below $2,000. For as little as $1,400 (the list price is $1,999), you get Adobe PostScript (17 fonts) and also PCL 4. On PC Labs' tests, the 8-ppm engine generated 7.9 ppm in PostScript mode and 8.1 ppm in PCL mode; It was the fastest in PCL mode graphics and tied for second among the built-in-PostScript printers. Its print quality was better than average. You can add a second paper bin for $329. Drawbacks? You pay an extra $399 to get an additional 18 PostScript fonts that are standard in many other printers, and there is no serial-port connection. (You get both in the otherwise similar Okidata OL840 for $600 extra.) Lastly, Okidata printers use separate toner cartridges that are messier than sealed Canon-engine cartridges.

Watch for a rash of fast new PostScript printers early next year once Adobe Systems releases drivers for PostScript Level 2. Traditionally, printer makers wrote their own drivers, but Adobe believes driver performance is so important that it's writing them, too. If you must have PostScript Level 2 now, your only choice is the Dataproducts LZR 960.

HP'S BEST PRINTER: THE IIIP

The best and most versatile personal printer is the $1,595 HP LaserJet IIIP, with PCL 5 scalable fonts and RET. Its output is every bit as good as that of the 8-ppm LaserJet III. While only half as fast as the LaserJet III on simple text, it takes barely 15 percent longer on many graphics and complex pages. For about the same as you would pay for a bare LaserJet III, you can add a second paper tray, PostScript, and extra RAM to the LaserJet IIIP. For many users, that will provide more versatility. You should be able to find the basic LaserJet IIIP for a price between $1,000 and $1,100. While other personal printers from Epson America, Okidata, and Panasonic Communications & Systems Co. may sell for as little as $600 to $800, we believe the LaserJet IIIP is a better printer. If you're really price-constrained, check out the just-announced HP LaserJet IIP Plus. At $1,249 list ($50 less than the discontinued IIP, and with a faster processor), it may be available for less than $900.

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Bézier BP4040

compatible desktop laser printers with list prices under $2,000. It is expected to sell for just under $1,400. Unfortunately, the promising start comes with some glitches—such as limited external-font options, poor documentation, and the lack of an easy-to-use control panel.

Using Microsoft TrueImage, the printer features 35 Apple TrueType fonts, which it uses to generate text in both PostScript and PCL mode. Although the BP4040 can sense whether you are hooked up to the parallel, serial, or AppleTalk interface, it does not do automatic emulation switching. To change emulations, you'll need to set a DIP switch on the back of the printer.

LIMITED FONT FLEXIBILITY

Unfortunately, the BP4040 has no slots for font cartridges or cards. And while it comes with 2MB of RAM—sufficient for most applications—Bézier does not offer any memory upgrades. So much for font libraries. (In a future version of the BP4040, Bézier plans to include a new controller that can accommodate a 2MB memory upgrade. The current model will not be upgradable, though.)

With the 16-MHz AMD 29000 RISC processor on the controller, the BP4040 did well on PC Magazine Labs' text speed test: It scored 3.9 pages per minute in PostScript mode and 3.8 ppm in PCL mode. On the graphics speed test, the BP4040 was an average performer, at 0.6 gppm in PostScript mode and 1.5 graphics pages per minute in PCL mode. Output quality on the text and graphics tests was respectable.

The BP4040 comes with a multipurpose 70-sheet paper cassette. You can feed envelopes from this cassette, but no more than five at a time. For $179, Bézier sells the 250-sheet bottom paper cassette that is a common option for Canon LX–based personal laser printers.

One drawback of the BP4040 is its lack of a control panel: It only has a line of indicator lights. Just above each light is an identifying symbol (none of which you can easily interpret without the help of the manual). There is no on-line or off-line selection or form feed. You select the paper feed from a switch on the BP4040's front. Warning: The optional bottom paper cassette is the default setting, and the side paper cassette that comes with the printer is used for manual output.

With Microsoft TrueImage PostScript compatibility, HP PCL 4, and RISC-processor speed, the 4-ppm BP4040 may be an attractive value. But be prepared to give up some conveniences (such as a well-designed control panel and clear documentation) and flexibility (such as font cartridges or cards) in exchange for the bargain-basement $1,400 street price.

FACT FILE

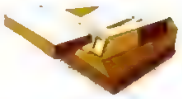
Bézier Systems Inc., 1190 Saratoga Ave., San Jose, CA 95129; 408-345-0345.
Bézier BP4040
List Price: $1,895; letter-size paper cassette, $179.
Standard Warranty: One year on parts and labor, with on-site service the first 90 days.
Dimensions (HWD): 8 x 28 x 14 inches.
Weight: 26 lbs.
Emulations: HP PCL 4, Microsoft TrueImage PostScript interpreter.

CIRCLE 420 ON READER SERVICE CARD

BROTHER INTERNATIONAL CORP.

Brother HL-8V
Brother HL-4PS

by Edward Mendelson

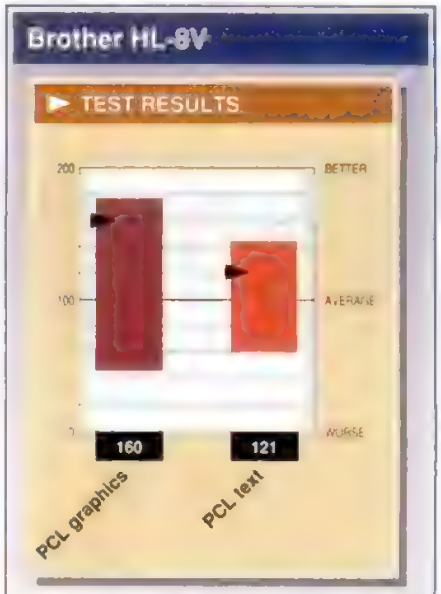


Besides Hewlett-Packard's own HP LaserJet IIIP, the only printer in this roundup that comes standard with HP PCL 5 compatibility is the 8-page-per-minute Canon SX–based HL-8V from Brother International Corp. Priced at $2,495, the HL-8V includes a clone of HP's Resolution Enhancement Technology (RET), called High Resolution Control. Brother's other laser offering is less unique: the $2,595 4-ppm Canon LX–based HL-4PS offers PostScript compatibility (Brother BR-Script) and support for PCL 4.

BROTHER HL-8V

In many ways, Brother's HL-8V is identical to the HP LaserJet III (which we reviewed in last year's special printer issue); it has the same Canon SX engine, the same interfaces, and the same paper handling (you can even use the cassettes designed for the LaserJet II and LaserJet III). With Brother's High Resolution Control, the HL-8V delivers image quality comparable to the LaserJet III. And with Brother's PCL 5 emulation, the HL-8V is the only printer to match the LaserJet III in PCL capability. What makes the HL-8V different from the LaserJet III is additional emulations—Brother TwinWriter, Diablo, Epson FX, and IBM Proprinter—faster graphics speed, automatic interface switching, and advanced memory management for large images.

The HL-8V performed impressively on our tests. In PCL mode, it did only slightly better than the LaserJet III: 7.6 pages per minute, compared with the LaserJet III's 7.5 ppm. But on graphics, the HL-8V sped through our tests at the

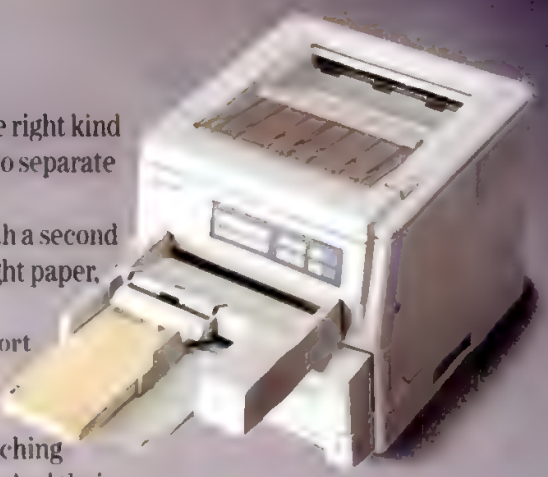


PCL scores

In Short: The first printer to come with HP PCL 5 emulation, the $2,495 8-ppm Brother HL-8V includes built-in Epson and Proprinter emulations that HP offers only through a cartridge. It surpasses the HP LaserJet III in graphics speed but inflicts compromises in compatibility, especially with PostScript cartridges.

PRODUCT PHOTOGRAPHY: THOM O'CONNOR

Sharp Laser Printers.



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Computer Gaming World
August 1991

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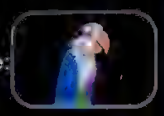
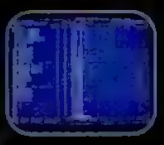
- SBTALKER - text-to-speech synthesizer with DR SBAITSO2
- Talking Parrot - voice in/out application.
- MMPLAY Multimedia Presentation
- CD music player
- Windows 3.0 DLL and sound applications





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CIRCLE 541 ON READER SERVICE CARD

rate of 2.8 graphics pages per minute—nearly 1.5 times as fast as the LaserJet III's 1.9 gppm. Brother attributes the speed improvements to three factors: the 12.5-MHz processor (the LaserJet III uses a 10-MHz processor), optimized firmware, and data compression.

On our PCL 5 compatibility test, the HL-8V produced results identical to the LaserJet III. In PCL mode, the HL-8V's built-in scalable fonts are close matches for the LaserJet III's CG Times and Univers families. You also get a third family, which resembles Bookman.

For cartridge compatibility, the HL-8V gets mixed reviews. The good news is that two slots under the paper cassette accept any standard LaserJet font cartridge. The bad news is that the printer doesn't work with any PostScript emulation cartridge or Pacific Data Products' programmable FontBank cartridge.

If you absolutely must have PostScript compatibility, Brother offers a controller board with BR-Script. But at $1,995, it is expensive and forces you to give up PCL 5 because the board supports only PCL 4.

You can upgrade the HL-8V's standard 1MB of RAM to 5MB. Brother's cheapest RAM board is a $299 1MB design, expandable to 4MB by using common memory chips. You cannot use HP-compatible boards.

The membrane switches on the HL-8V's control panel, slightly more complicated than the LaserJet III's, let you choose emulation, orientation, fonts, and other standard functions. The 16-character LED speaks in six languages.

Except for its incompatibilities with FontBank and PostScript cartridges, and its HP-compatible memory boards, the Brother HL-8V is a solid clone of the LaserJet III, and it is faster on graphics. If you can get it for a street price as low as the LaserJet III, and PCL 5 satisfies your desire for scalable fonts, the HL-8V is a respectable alternative to the LaserJet III.

BROTHER HL-4PS

Except for the crucial fact that it has a built-in PostScript emulation, Brother's $2,595 HL-4PS could serve as a stand-in for HP's LaserJet IIP (reviewed last year). This 4-ppm 300-dot-per-inch printer, which emulates PCL 4, uses the same Canon LX engine as the LaserJet IIP and fits inside an almost identical outer case. This is a well-designed printer, and its standard 2MB of RAM (upgradable only with Brother's proprietary boards) is adequate for almost all PostScript jobs.

Instead of Adobe PostScript, Brother uses its proprietary BR-Script clone interpreter, which operates at a comparatively slow graphics speed—0.3 gppm on PC Labs' test. Its text speed in PostScript mode was 3.8 ppm, a respectable result for a printer in its class. In PCL mode, the HL-4PS printed text at 3.9 ppm and graphics at 0.3 gppm. In both modes, the HL-4PS was slightly slower than the LaserJet IIIP.

BR-Script supports Type 1 fonts and produces clean output. However, its 35 internal fonts are named with baffling numbers and letters, not the familiar Adobe PostScript font names. The HL-4PS has two slots for Brother's proprietary font cards, which are not HP-compatible.

To the standard LaserJet II fonts, Brother adds its own proprietary scalable equivalents of Helvetica and Times. The widths of these fonts are the same as those used in PostScript mode, which means they won't exactly match the Helvetica and Times used in LaserJet cartridges.

The HL-4PS's paper handling is comparable with that of the LaserJet IIP (but not with the LaserJet III's enhanced capacity). You can fit 50 sheets into the built-in paper cassette and 250 sheets into the optional $195 bottom paper cassette.

The Achilles heel of the HL-4PS is its manual, which never explains options you must understand when switching from PCL to BR-Script mode. If you can figure out that "BR-Script (I)" means the interactive PostScript mode (which you probably won't want to use) and that "BR-Script (B)" means the standard (or batch) mode, you will have no trouble.

Ultimately, the Brother HL4-PS suffers next to the LaserJet IIIP, which has an optional Adobe-licensed PostScript cartridge. For roughly the same price as the Brother HL-4PS (including the extra memory for PostScript), the LaserJet IIIP will give you PCL 5, better paper handling, and slightly faster speeds.

Brother HL-4PS

PCL and PostScript scores

In Short: At a list price well above the magic $2,000 mark, the $2,595 Brother HL-4PS suffers in comparison with faster PostScript-compatible printers with lower prices. For the same cost as this PCL/PostScript offering, HP will sell you the HP LaserJet IIIP and an Adobe PostScript cartridge. The HL-4PS uses a Canon LX engine and Brother BR-Script.

FACT FILE

Brother International Corp., 200 Cottontail Ln., Somerset, NJ 08875; 908-356-8880.

Brother HL-8V

List Price: $2,495; 3MB RAM upgrade, $299; font cartridges, $295 to $465; second letter-size paper cassette, $89; legal-size paper cassette, $99; Brother BR-Script PostScript-compatible controller board, $1,995.

Standard Warranty: One year on parts and labor.

Dimensions: 9 x 18 x 25 inches.

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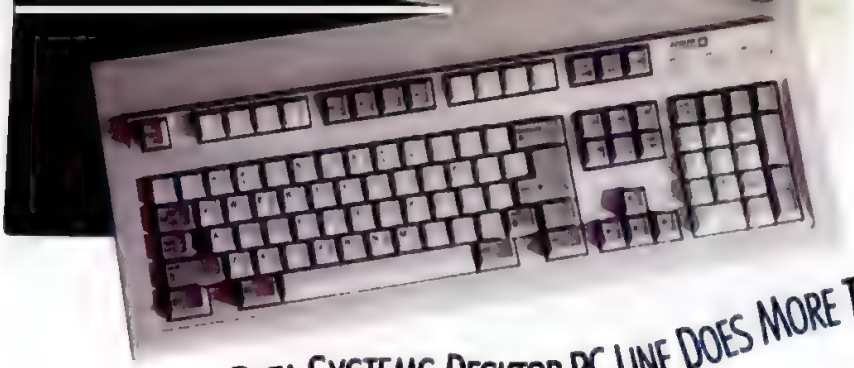

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Expansion Slots	4 open 16-bit ISA	3 open 32-bit EISA	3 open 32-bit EISA	8 open 32-bit EISA	2 open 16-bit ISA
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Ports	2 serial, 1 parallel	2 serial, 1 parallel	2 serial, 1 parallel	2 serial, 2 parallel, 1 mouse	2 serial, 1 parallel
Disk Drive Controller	Combined IDE connector/ floppy controller	Combined IDE connector/ floppy controller	Combined IDE connector/SCSI/ floppy controller	EISA bus master SCSI mass host adapter	IDE connector/ floppy controller
Video	16-bit VGA card	16-bit VGA card	TIGA/VGA	16-bit VGA card	16-bit VGA on board
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Weight: 44 lbs.
Emulations: Brother TwinWriter, Diablo, Epson FX, HP PCL 5, IBM Proprinter.

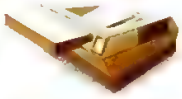
Brother HL-4PS
List Price: $2,595; 1MB RAM upgrade, $495; 2MB RAM upgrade, $990; 4MB RAM upgrade, $1,980; font cards, $195 each; letter-size paper cassette, $195; legal-size paper cassette, $79; executive-size paper cassette, $75; envelope cassette, $99.
Standard Warranty: One year on parts and labor.
Dimensions: 8 x 16 x 14 inches.
Weight: 27 lbs.
Emulations: Brother BR-Script PostScript interpreter, HP PCL 4.

CIRCLE 421 ON READER SERVICE CARD

C-TECH ELECTRONICS INC.

C. Itoh ProWriter CI-4

by Rink Murray



Laser printers based on the 6-page-per-minute engine from Tokyo Electronics Corp. (TEC) have been commonplace for two years, but the C. Itoh ProWriter CI-4 (a joint venture of C. Itoh and TEC) is the first printer we have seen that uses TEC's new 4-ppm engine. On our tests, the ProWriter provides performance and output quality comparable to last year's Canon LX–based HP LaserJet IIP. And with a list

C. Itoh ProWriter CI-4

price of $1,245, the PCL 4–compatible ProWriter costs a bit less—approximately $700 on the street, compared with $800 for the LaserJet IIP. PostScript compatibility is also inexpensive: You can add it for as little as $910 ($450 for a Destiny PostScript-compatible cartridge, plus $460 for 2MB of RAM).

The ProWriter ships with HP PCL 4 only; Diablo and Epson emulations are available for $190 each. The printer accepts HP-compatible cartridges, and it comes standard with 512K of RAM, which you can expand to 2.5MB (RAM upgrades are $230 per megabyte). Paper handling includes a face-down output mode as well as a straight paper path. The standard paper cassette has a 100-sheet capacity, and an optional 300-sheet paper cassette is available for $175.

Setting up the ProWriter is a bit complicated. You must perform no fewer than 12 steps before you can turn it on (such as assembling the developer block, installing the drum counter, and checking the ozone). The instructions are clear and the diagrams helpful, but fortunately you will only have to go through this lengthy process once. The control panel is generous; eight buttons, three LEDs, and a 16-character LCD help you navigate your way through any changes you want to make.

On the speed tests, the ProWriter performed in line with the Canon LX–based printers. It scored exactly 4.0 pages per minute on text (the LaserJet IIP produced 3.9 ppm when we tested it last year) and 1.4 graphics pages per minute on our graphics speed test (the LaserJet IIIP was faster, at 1.6 gppm, but the LaserJet IIP scored only 1.1 gppm). Output was on a par with that of the LaserJet IIP (but not with the LaserJet IIIP's, which uses Resolution Enhancement Technology).

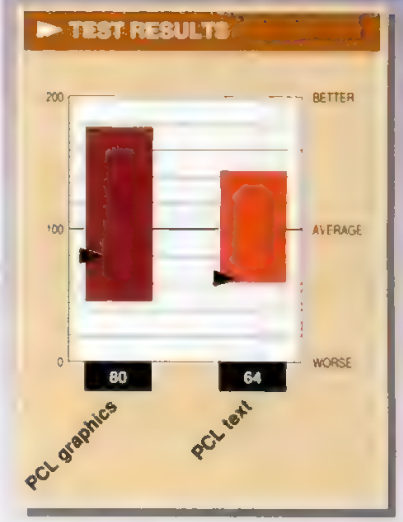
Selling for around $700, the C. Itoh ProWriter is an acceptable low-cost alternative to the LaserJet IIP. This fall, expect to see offerings based on the new 4-ppm TEC engine from other vendors.

FACT FILE

C-Tech Electronics Inc., 2515 McCabe Way, P.O. Box 19673, Irvine, CA 92713-9673; 800-347-4017, 714-833-1165.
C. Itoh ProWriter CI-4
List Price: $1,245; 1MB RAM upgrade, $230; Destiny PageStyler PostScript PDL Cartridge, $450; Diablo, Epson FX, HPGL, and IBM Proprinter emulations, $190 each; second letter-size paper cassette, $175.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 8 x 14 x 23 inches.
Weight: 29 lbs.
Emulations: HP PCL 4.

CIRCLE 422 ON READER SERVICE CARD

C. Itoh ProWriter CI-4



PCL scores

In Short: Based on a new 4-ppm engine from TEC, the $1,245 C. Itoh ProWriter CI-4 is an inexpensive alternative to last year's HP LaserJet IIP. The standard configuration, which includes HP PCL 4 and 512K of RAM, is available for as little as $700.

DATAPRODUCTS CORP.

Dataproducts LZR 960

by Bill O'Brien

As the first laser printer to support Adobe PostScript Level 2, the Dataproducts LZR 960 is certainly newsworthy. (The solid-ink Tektronix Phaser III PXi, reviewed in the section on color PostScript printers, is the only other printer in this roundup that supports Adobe PostScript Level 2.) Equally interesting are its fast new 9-page-per-minute engine from Sharp and a RISC processor on-board its controller. Including PCL 4, the $2,995 LZR-960 is expected to sell on the street for around $2,200, making it a headliner.

The wonders of PostScript Level 2 are undeniably legion, but Dataproducts Corp., which has been developing printers since 1962, didn't stop at simply implementing the new language. PostScript is slow, and while Level 2's enhanced operators will help speed things up, the LZR 960 also uses a Weitek RISC-based controller running at 6.5 MHz to give the printer an added boost.

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• Dataproducts LZR 960

SPEEDY PERFORMER

The combination of PostScript Level 2 and the RISC-based controller showed up in the solid scores the LZR 960 delivered on our speed tests. The LZR 960 performed better in PostScript mode—8.1 ppm—than in PCL mode—7.9 ppm. Even so, the LZR 960 was faster than last year's HP LaserJet III, which printed 7.5 ppm. On our graphics speed tests, the printer was faster in PCL mode than in PostScript mode: 1.6 graphics pages per minute in PCL (slower than the LaserJet III, which produced 1.9 gppm) and 0.7 gppm in PostScript mode.

In the process, Sharp's laser engine produced very crisp, well-defined graphics and text under both emulations. (PC Magazine Labs' tests are designed to test PostScript Level 1 printers and currently do not contain Level 2–specific operators.)

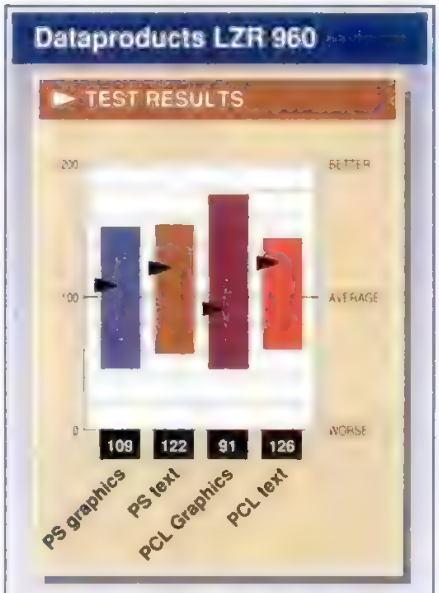
The Sharp engine uses separate toner, developer, and drum cartridges rather than a single unit, as the Canon engines do. The 300-dot-per-inch Sharp engine is wrapped in an 11- by 13- by 14-inch chassis. These dimensions include the paper cassette (which does not protrude), making the LZR 960 one of the most space-conserving printers on the market. (There is a face-up exit tray, but under normal conditions, this is folded flat against the back of the printer.) Input connections are standard for a PostScript printer and include parallel, serial, and AppleTalk ports. The LZR 960 switches automatically to the active port, and a SCSI connector is included for a hard-disk installation.

You make print option selections through a front-mounted control panel. A 16-character LCD displays your choices. Paper-cassette selection software exists for the Macintosh, but for the PC, the control panel governs switching among the standard 250-sheet paper cassette, the optional 250-sheet paper cassette ($369), and the optional envelope cassette ($399), which has a capacity of 40 envelopes. The printer also features an Auto Tray option that automatically kicks in the second paper cassette if both cassettes hold the same-size paper. With a total feed capacity of 500 sheets, you will have to keep an eye on the face-down exit pocket's 230-sheet capacity. (The face-up stacker will hold only 30 sheets.)

The LZR 960's hierarchical menuing system is not easy to navigate the first few times you use it, but the manual is superb in detailing the steps you need to reach any option on the various trees. That quality holds true throughout the manual, even though it's not the slickest booklet you will ever find. A short video that comes packaged with the printer guides you through the initial setup and use.

The combination of a one-year warranty with optional on-site service, a technical support line, a full-time BBS (with a downloadable software-driver library), and a technical-support fax line gives the LZR 960 one of the most comprehensive user-support packages available.

To date the only laser printer with PostScript Level 2, the Dataproducts LZR 960 is an attractive high-end choice.



PCL and PostScript scores

In Short: Fast and exciting, the 9-ppm Sharp engine–based $2,995 Dataproducts LZR 960 is the only desktop laser printer in this roundup to support PostScript Level 2. HP PCL 4 also comes standard.

FACT FILE

Dataproducts Corp., 6219 DeSoto Ave., Woodland Hills, CA 91367-2602; 800-334-3174, 818-887-8000.

Dataproducts LZR 960

List Price: $2,995; 1MB RAM upgrade, $299; 2MB RAM upgrade, $599; 4MB RAM upgrade, $1,199; 8MB RAM upgrade, $2,399; second letter-size paper cassette, $369; envelope cassette, $399.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 11 x 13 x 14 inches.

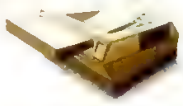
Weight: 34 lbs.

Emulations: Adobe PostScript Level 2, HP PCL 4.

CIRCLE 423 ON READER SERVICE CARD

DIGITAL EQUIPMENT CORP.

DEClaser 1150
DEClaser 2150
DEClaser 2250



by Alfred Poor

Digital Equipment Corp. made its reputation by creating small computers back in the days when "small" meant minicomputer. Ever since the IBM PC kicked the microcomputer revolution into high gear, DEC has been searching for ways to play a part in this market while maintaining a connection to its minicomputer products. The company's endeavors have brought it to the PC printer market. We cover three desktop laser printers here: the 4-page-per-minute $3,049 DEClaser 1150, based on the Canon LX engine; the 8-ppm $3,499 DEClaser 2150, based on the Canon SX engine; and the 8-ppm $5,149 DEClaser 2250, based on the Canon RX engine. All three will appeal mostly to those who already have DEC equipment; their prices are high and feature sets low, compared with those of most competing printers, so many PC users will find better values elsewhere.

Unlike DEC's previous offerings, which supported only DEC printer languages (and were therefore ineligible for

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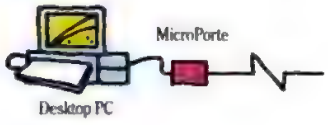

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review in *PC Magazine*), this year's trio provides Adobe PostScript (and the DEClaser 1150 handles HP PCL as well), and all are based on Canon print engines. They also keep the connection to their minicomputer heritage, however, with support for the DEC LN03 printer command set. In fact, the models reviewed here are based on LN03-compatible units but add extra memory and a PostScript cartridge.

DECLASER 1150

The $3,049 4-ppm DEClaser 1150, based on the familiar Canon LX engine, features Adobe PostScript and a PCL 4 emulation. The smallest of the three printers, it is fairly simple to set up; the toner, developer, and drum are all contained in a single, convenient cartridge. The case is made from an olive-gold plastic, which is a refreshing change from the off-white shades used for most computer equipment.

You can also turn a base-priced DEClaser 1100 into a DEClaser 1150 PostScript model by adding a 2MB memory card (which you have to install—DEC doesn't do it) and a PostScript cartridge. The PostScript cartridge must reside in the leftmost of two font-cartridge slots. Unlike the font cartridges of Hewlett-Packard printers, which provide only a single slot, the DEC cartridges are small and thin IC packages, closer in size and shape to a thick credit card. Paper handling is the same as that of the HP LaserJet IIP, HP LaserJet IIIP, or other LX engine–based machines: It has a 50-sheet paper cassette and an optional $199 250-sheet bottom-feed paper cassette. The paper path is C- or S-shaped, depending on whether you're using face-up or face-down output.

The printer was slow in its PostScript performance, rating just 3.8 ppm on the text speed test and coming in last on the graphics speed test, with 0.4 graphics pages per minute. To change to PCL mode, you must use the front-panel controls. But under PCL 4, the printer was faster: 3.9 ppm for text (the same as last year's LaserJet IIP), and 0.8 gppm for graphics (a little slower than the LaserJet IIP, which delivered 1.1 gppm).

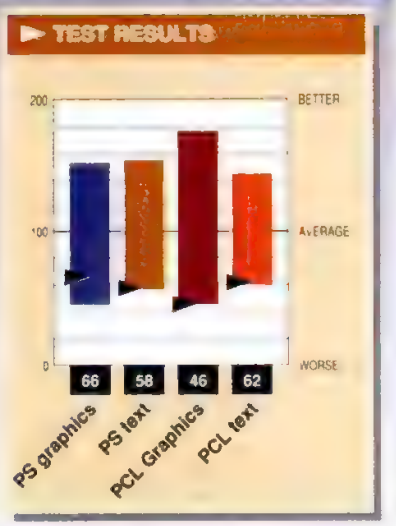
There were no compatibility problems with our tests. The printer managed the PCL 4 torture-test page with aplomb and also demonstrated support for the PCL bit-image compression mode that the LaserJet IIP supports. The printer comes with 43 resident PostScript font outlines, and you can access a number of these in PCL mode. Print quality of the DEClaser 1150 is excellent; solid black areas showed even coverage, with no signs of fading in the middle and no ragged edges along the bottom.

The biggest problem with the DEClaser 1150 is its price: There are other PostScript printers with 4-ppm engines available at far lower prices. The main distinguishing feature is the optional DECprint Printing Services for VMS environments, but this is likely to be of interest to a limited portion of those looking to buy a laser printer.

DECLASER 2150 AND DECLASER 2250

The $3,499 DEClaser 2150 and $5,149 DEClaser 2250 are both based on 8-ppm Canon print engines. The 2150 model uses the SX engine (as do the HP LaserJet II and LaserJet III), while the DEClaser 2250 is built around the RX engine, which offers dual paper cassettes and duplex printing (as do the HP LaserJet IID and LaserJet IIID). The single cartridge (containing toner, developer, and drum) makes

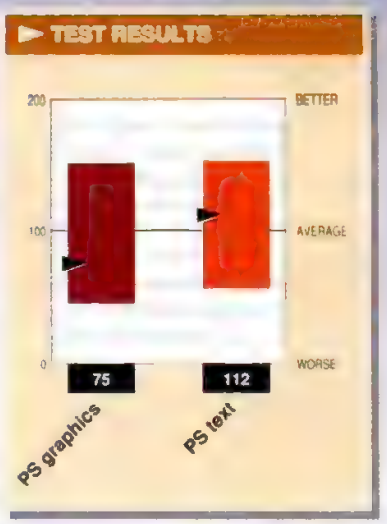
DEClaser 1150



PCL and PostScript scores

In Short: Based on the Canon LX engine, the DEClaser 1150 is a 4-ppm Adobe PostScript printer that includes an HP PCL 4 emulation. Performance is slow, and at $2,849, the price is high, making the unit less attractive than its competition.

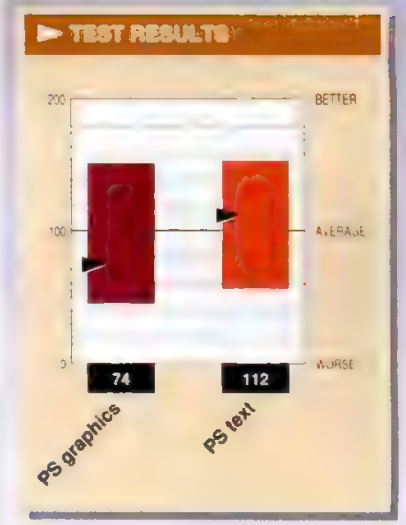
DEClaser 2150



PostScript scores

In Short: The DEClaser 2150 is an Adobe PostScript printer based on the 8-ppm Canon SX print engine. The print quality is good, but the speed is average at best, and the printer's competitive value is reduced by its high $3,499 price.

DEClaser 2250



PostScript scores

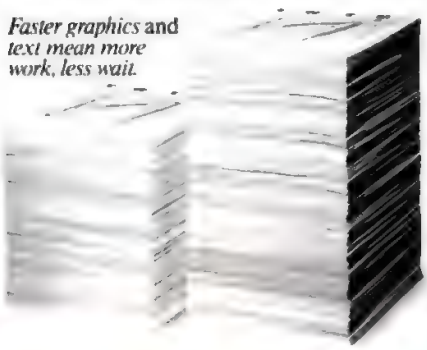
In Short: The DEClaser 2250 offers Adobe PostScript and duplex printing in an 8-ppm Canon RX engine. Like the 2150, the performance scores are average and quality is good, but the high $5,149 price reduces the printer's appeal in the competitive PC printer market.

Announcing
the new
IBM LaserPrinters.
Suddenly, other printers
are a few pages
behind.

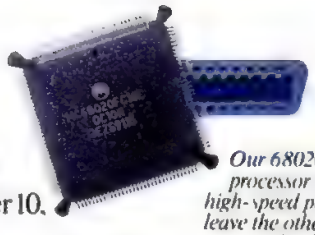
With 45% faster graphics, the keeps you way ahead

In the time it takes the HP LaserJet III to print this much...

As you can see, this is a printer with legs. In fact, for the new IBM® LaserPrinter 10, 45% faster graphics is just a warm-up. Shift into optional PostScript® mode, and the LaserPrinter 10 is a full two-and-a-half times as fast as the LaserJet III in PostScript mode. And those are just averages. The more complex your page, the more time you save.



Faster graphics and *text mean more work, less wait.*



Our 68020 processor and high-speed ports leave the other guys in the dust.

At the heart of the new LaserPrinter 10, a Motorola 68020 processor makes short

The new LaserPrinters definitely speak your language.

THE NEW IBM LASER

new IBM LaserPrinter 10 of the other guy.

...the IBM LaserPrinter 10 gives you the whole picture.

work of tough graphics. A 10-page-per-minute print engine boosts speed further, so even plain text prints 25% faster than the LaserJet® III. High speed ports accept data up to 15 times faster, too, to unjam LANs and keep people working, not waiting.

If you're wondering how all this speed fits into your system, don't. Every new IBM LaserPrinter has three built-in data streams, *including* built-in HP LaserJet II emulation. There are drivers from the major software makers, and LaserJet III emulation and Adobe® PostScript are optional. So LaserPrinters save you not just time, but headaches.

The IBM LaserPrinter 10, one of four new LaserPrinters.

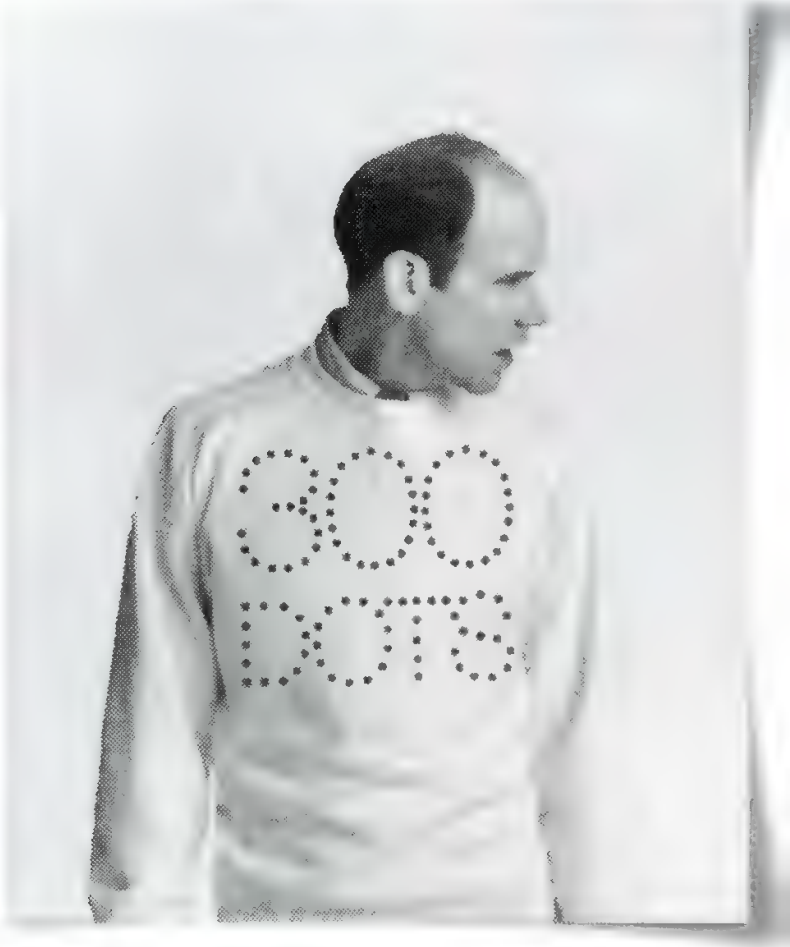
There's a whole family of new IBM LaserPrinters, designed to outrun the competition in print quality, paper handling, and more. So keep your eyes on the next few pages. You'll see how the new IBM LaserPrinters put you precisely where you want to be: ahead.

Graphics speed comparisons based on captured, compressed image data files. PostScript files sourced from Microsoft® Soft Print® test case, running files captured from output of application drivers.

PRINTERS. PAGES AHEAD.

At 600 x 600 dpi, the
does wonders for any

HP LaserJet III with PostScript option: 300 x 300 dpi, max.



There's no end to the ways the new IBM LaserPrinters can make a body look good.

First, there's an Adobe PostScript option that delivers a true 600 x 600 dots per inch. It gives you up to *four times* the resolution of PostScript on any HP LaserJet. Camera-ready output, on your desktop, for thousands of dollars less than ever before.

But the eye-catching advantages of the new IBM LaserPrinters aren't reserved just for PostScript users.

LaserJet

IBM

HP LaserJet jump-gap toner system vs. our contact-transfer. A clean win for the IBM LaserPrinter. (10x enlargement)

Courier
Courier Oblique
Courier Bold
Courier Bold Oblique
Times New Roman
Times New Roman Italic
Times New Roman Bold
Times New Roman Bold Italic
Helvetica
Helvetica Italic
Helvetica Bold
Helvetica Bold Italic
Helvetica Narrow
Helvetica Narrow Italic
Helvetica Narrow Bold
Helvetica Narrow Bold Italic

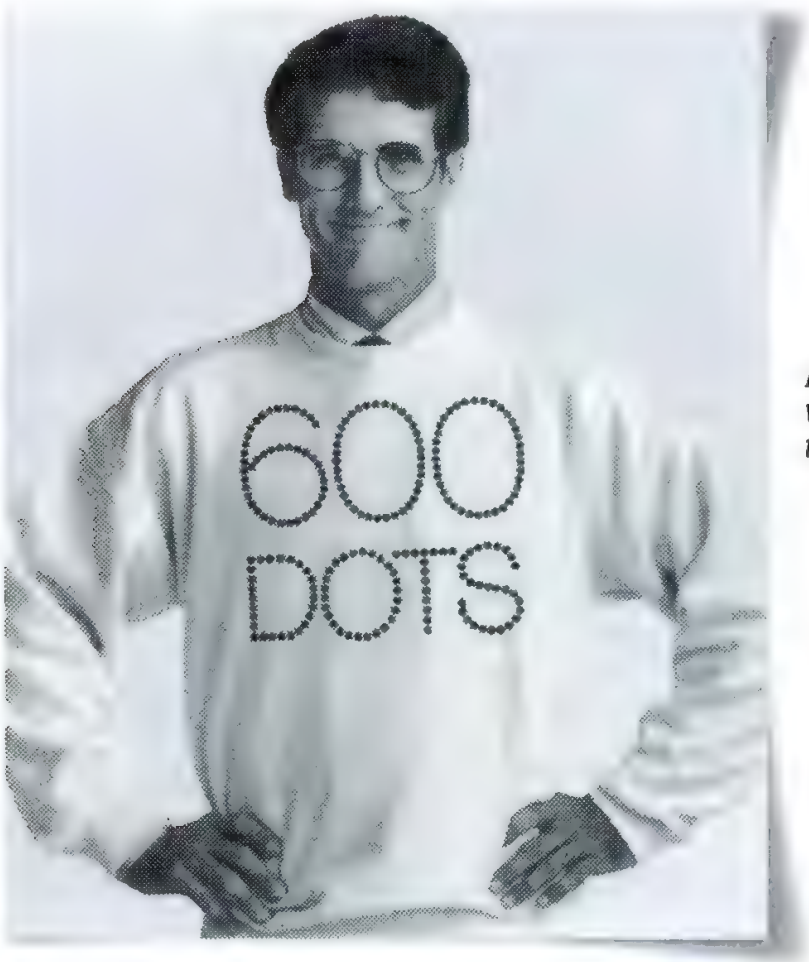
Times
Times Bold
Times Italic
Times Bold Italic
Univers
Univers Bold
Univers Italic
Univers Bold Italic

Sixteen scalable fonts, built in—twice as many as an HP LaserJet. And our fonts are Type-1. Theirs aren't.

300 x 300 dpi PostScript optional on all LaserPrinter models; requires total of 2MB memory. Models 6, 10 and 10L upgradable to 600 x 600 dpi PostScript, requires total of 5MB memory. Motorola and the Motorola logo are registered trademarks of Motorola, Inc. WordPerfect is a registered trademark of WordPerfect Corporation. Windows 3.0 is a registered trademark of Microsoft Corporation. Lotus is a registered trademark of Lotus Development Corporation.

THE NEW IBM LASER

new IBM LaserPrinter image. Especially yours.



IBM LaserPrinter with PostScript option: 600 x 600 dpi—up to four times the resolution.

Sixteen built-in scalable fonts are standard equipment—twice as many as the LaserJet III. They're Type-1 fonts with Adobe scaling technology, online and always ready, without waiting for downloads.

Also standard on every new LaserPrinter: crisper type and graphics than ever, thanks to sophisticated new Print Quality Enhancement Technology (PQET). There's more precise toner transfer than any LaserJet, and finer line weights. And fast, easy control-panel settings no LaserJet offers, for light/normal/dark print, and smooth or rough paper settings.

LaserJet RET *IBM PQET*

RR

Can't see the difference? No wonder. Our PQET enhancement is the equal of anything in the industry.

The new IBM LaserPrinters: the leading edge, made sharper.

Right from page one, the new IBM LaserPrinters make everything from simple correspondence to slick desktop publishing look crisp, clean, and cutting-edge.

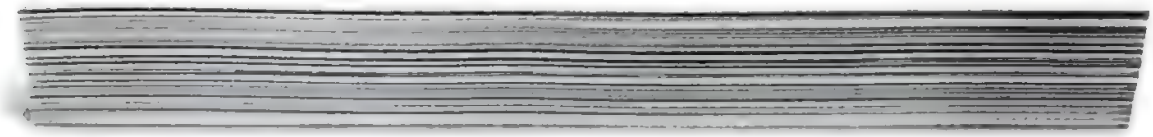
Which makes you look extraordinarily sharp too.

Adobe and PostScript are registered trademarks of Adobe Systems Inc. HP and LaserJet are registered trademarks of Hewlett-Packard Company. Times New Roman is a trademark of Monotype Corp., PLC. Helvetica and Times are trademarks of Linotype-Hell AG and/or its subsidiaries. OS/2 is a registered trademark of IBM Corp. IBM is a registered trademark of IBM Corp. in the United States and/or other countries and is used under license.

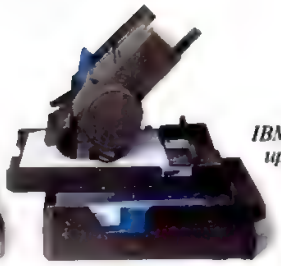
PRINTERS. PAGES AHEAD.

With 3½ times the paper capacity, lets you relax,

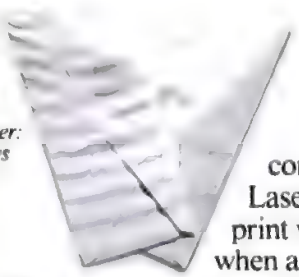
HP LaserJet III: 200-sheet limit; second tray or larger tray options not available.



HP LaserJet III: sorry, one tray at a time.



IBM LaserPrinter: up to three trays at once, for automatic collating.



Envelope Conditioning on Models 10 and 10L fights unsightly wrinkles.

For an antidote to everyday office stress, try the superb paper-handling options of the new IBM LaserPrinters.

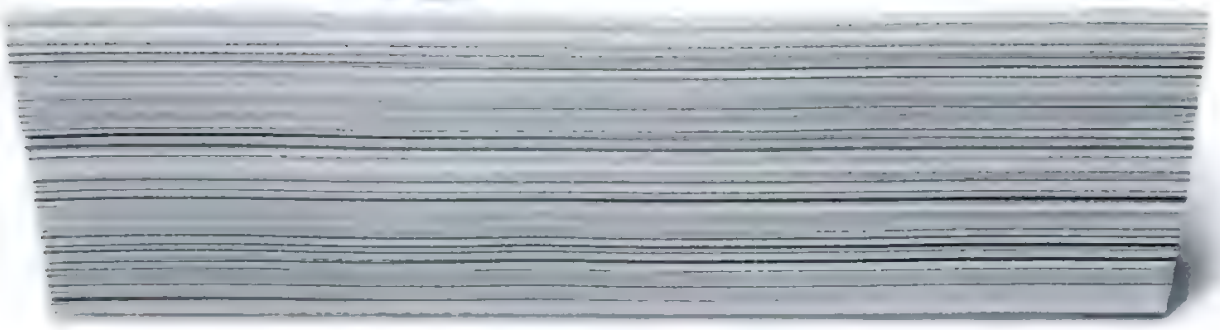
Most models can use three paper trays at once, automatically. So you can print and collate letterhead, second sheets and envelopes, without swapping trays. Need expertise with envelopes? No leading laser printer even comes close to the IBM LaserPrinters. They adjust print weight automatically when an envelope is fed in. Our optional 75-envelope feeder holds five times as many as the LaserJet III tray. And on the LaserPrinter 10 and 10L, our exclusive Envelope

Optional trays smoothly handle card stock, labels, overheads.

THE NEW IBM LASER

the new IBM LaserPrinter not reload.

IBM LaserPrinter: 700 pages without reloading, using optional 500-sheet second tray.



Conditioning fights wrinkling.

There's a special optional tray for heavy card stocks and labels, and a front exit to keep them flat.

And along with all this efficiency, there's economy. "Smart" paper trays adjust to multiple paper sizes, unlike LaserJet trays. Trays are interchangeable among LaserPrinter models, again unlike the LaserJet.

Zero-footprint, 500-sheet second tray is standard on the Model 10L, optional on Models 6 and 10.

One more economics lesson: LaserPrinter toner cartridges give you significantly more pages than any LaserJet cartridge—up to twice as many pages between replacements.

In short, the new IBM LaserPrinters give you economy and paper handling the competition can't touch. With this kind of work-hungry, cost-conscious office help, you can actually afford to relax.

500-sheet tray and front exit not available on Model 5E.

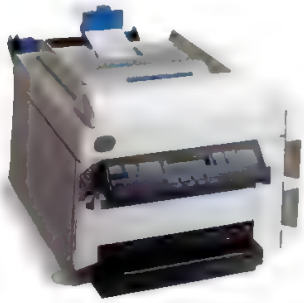
PRINTERS. PAGES AHEAD.

The LaserPrinter you buy today won't be out of date tomorrow.

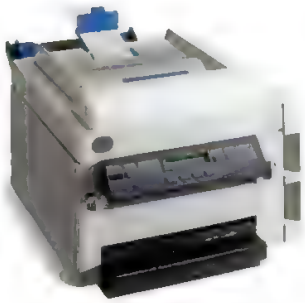
No matter how quickly your printing needs change, the new IBM LaserPrinters can change with them. Any six-page-per-minute machine can be easily upgraded to a full 10 pages per minute. Auxiliary trays can be added any time, and moved quickly from machine to machine, or from model to model. Adobe PostScript upgrades and additional memory are easy to install yourself, in minutes, and are interchangeable among LaserPrinter models. And one toner cartridge design fits every LaserPrinter.

Modular design means IBM LaserPrinters are uniquely qualified to deal with the business world's one certainty: uncertainty.

***LaserPrinter 10L**—10 ppm, Motorola 68020 16.7 MHz, 700-sheet input, 250-sheet output, Envelope Conditioning, automatic emulation switching. $2995 suggested retail. Optional: 75-envelope tray, Adobe PostScript 600 x 600 dpi, HP PCL5 emulation.*



***LaserPrinter 10**—10 ppm, Motorola 68020 16.7 MHz, 200-sheet input, 100-sheet output, Envelope Conditioning. $2395 suggested retail. Optional: 500-sheet paper tray, 75-envelope tray, Adobe PostScript 600 x 600 dpi, HP PCL5 emulation.*



***LaserPrinter 6**—6 ppm, 200-sheet input, 100-sheet output. $1895 suggested retail. Optional: upgrade to 10 ppm, 500-sheet paper tray, 75-envelope tray, Adobe PostScript 600 x 600 dpi, HP PCL5 emulation.*

***LaserPrinter SE**—5 ppm, 200-sheet input, 100-sheet output. $1595 suggested retail. Optional: 75-envelope tray, Adobe PostScript 300 x 300 dpi, HP PCL5 emulation*

LaserPrinters and LANs.

Printers this productive deserve to be shared, and a host of networking options makes it easy. For Ethernet or Token-Ring LANs, there's the IBM 4033 LAN connection for OS/2® and AIX® users. For Macintosh users, there's the IBM LaserPrinter Option for AppleTalk® Networks, and for Novell® NetWare® environments, the NetPort® print server from Intel.® Network-ability is one more way the new IBM LaserPrinters put you ahead, and keep you there.

IBM® LaserPrinters

LEXMARK™

Manufacturer and distributor of IBM LaserPrinters.

To learn more about the family of new IBM LaserPrinters, call for your nearest dealer: 1 800 IBM-2468, ext. 804. In Canada, call 1 800 465-1234.

AIX is a trademark of International Business Machines Corporation. NetPort and Intel are registered trademarks of Intel Corp. Novell NetWare is a registered trademark of Novell Inc. Apple AppleTalk and Macintosh are registered trademarks of Apple Computer Inc. © 1991 Lexmark International, Inc. All output produced with the new IBM LaserPrinter 10 at 600 x 600 dpi.

THE NEW IBM LASERPRINTERS.

installation and maintenance a breeze.

As with their smaller stablemate, the DEClaser 1150, these two printers are based on earlier DEClaser models (the DEClaser 2100 and DEClaser 2200) that emulate only a DEC LN03 printer. And as with the DEClaser 1150, you can upgrade them via a user-installed 2MB memory card (though DEC sent us evaluation units with an optional 3MB card instead) and a credit-card-size PostScript cartridge. The true Adobe PostScript comes with the same 43 font outlines as the smaller printer.

Unlike the DEClaser 1150, these two larger printers have an extra step in the PostScript installation. The printers come with an second cartridge that contains a program, which tests the nonvolatile RAM used for storing printer configuration settings. Our evaluation units passed the test, but according to the documentation, they would have been usable even had they failed. They would require service if you wanted them to store configuration settings, but they would work as long as they were reconfigured each time you turned them on.

Also unlike the DEClaser 1150, the DEClaser 2150 and DEClaser 2250 do not include a PCL emulation. The printers performed adequately on PC Magazine Labs' speed tests; both turned in 7.4 ppm on the text speed test and 0.5 gppm on the graphics speed test. With smooth blacks and sharp lines, print quality was excellent.

Again, the main problem with these printers is price. There are other 8-ppm PostScript printers on the market at significantly lower prices, and some of the printers in this dollar range are much faster or offer additional features.

FACT FILE

Digital Equipment Corp., 146 Main St., Maynard, MA 01754; 800-344-4825; 508-493-5111.

DEClaser 1150
List Price: $3,049; Canon LBP8 and IBM Proprinter emulations, $299 each; font cartridges, $299 each; bottom letter-size paper cassette, $199; legal-size, executive-size, or A4-size paper cassette, $69 each; envelope cassette, $89.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 8 x 14 x 16 inches.
Weight: 25 lbs.
Emulations: Adobe PostScript, Apple LaserWriter Plus, DEC LN03, DECPrint Printing for VMS, HP PCL 4.

DEClaser 2150
List Price: $3,499; Canon LBP8 emulation, $299; font cartridges, $299 each; complete font library kit, $999; large-capacity letter-size paper cassette, $799; legal-size paper cassette, $79; executive-size paper cassette, $75; A4-size paper cassette, $69; envelope cassette, $89.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 9 x 18 x 21 inches.
Weight: 45 lbs.
Emulations: Adobe PostScript, Apple LaserWriter Plus, DEC LNO3.

DEClaser 2250
List Price: $5,149; Canon LBP8 emulation, $299; font cartridges, $299 each; large-capacity letter-size paper cassette, $799; legal-size, executive-size or A4-size paper cassette, $69 each; large-capacity envelope cassette, $399; standard envelope cassette, $89.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 12 x 18 x 27 inches.
Weight: 67 lbs.
Emulations: Adobe PostScript, Apple LaserWriter Plus, DEC LNO3.

CIRCLE 424 ON READER SERVICE CARD

EASTMAN KODAK CO.

Eastman Kodak Ektaplus 7008

by Wendy Dugas Pérez

Based on the 8-page-per-minute TEC 1306C laser engine, the $1,395 Eastman Kodak Ektaplus 7008 has a list of features typical of an HP LaserJet II clone. It has HP PCL 4 and HPGL emulations, and it provides average performance and acceptable output quality. If you can find it for a low street price, the Ektaplus 7008 may be just the ticket.

The Ektaplus 7008 delivered average times on PC Magazine Labs' speed tests: 7.4 ppm on text speed and 1.7 graphics pages per minute on graphics speed. The graphics quality of the Ektaplus 7008 was average, if a little dark, for PCL 4 emulations. The printer offers only 14 resident fonts, including Courier and Line Printer typefaces, but it does include two HP-compatible font-cartridge slots. The Ektaplus 7008 comes equipped with 1.5MB of RAM, and you can purchase a 1MB upgrade for $250.

The Ektaplus 7008 has room for one variable-size paper cassette, which handles a maximum of 200 sheets, and a paper-weight range from 16 to 34 pounds. If you regularly print large loads, be aware that this is the only paper cassette available for the printer—standard or optional. You can, however, feed envelopes manually, and the printer can handle output up to 200 collated sheets or 20 face-up sheets.

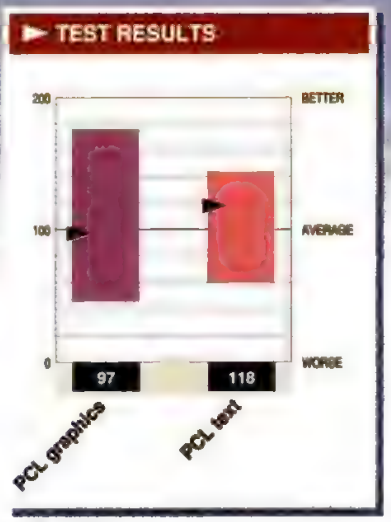
Installation proved to be as simple as removing the Ektaplus 7008 from the box and following the instructions in the manual, although several pages were missing from the installation section in the manual that was delivered with it. Eastman Kodak says this problem has been corrected for current shipments. Although the TEC engine has a three-part

In PCL mode, Okidata took first place on the graphics speed test—beating all the desktop lasers we have ever tested.

photoconductor system, it was not difficult to install the photoconductor and toner cartridge, connect the cables, and install the paper cassette.

Although the Eastman Kodak Ektaplus 7008 has nothing to make it stand out from the crowd of desktop laser printers reviewed in this roundup, it also has nothing to make you think twice, except perhaps the lack of a PostScript upgrade. If you're satisfied with LaserJet II–comparable performance and features, this is a perfectly respectable clone.

Eastman Kodak Ektaplus 7008



PCL scores

In Short: The $1,395 Eastman Kodak Ektaplus 7008 is a respectable HP LaserJet II clone based on the 8-ppm TEC engine. The only aspect that might make you think twice is the lack of a PostScript option.

PERFORMANCE TESTS: POSTSCRIPT-COMPATIBLE DESKTOP LASER PRINTERS

Nearly all 35 desktop laser printers we reviewed offered PostScript compatibility as a standard or optional feature. Only 5 failed to provide a path to PostScript.

Among the 23 desktop lasers that have PostScript compatibility as a standard feature, the Panasonic KX-P4455 Laser Partner won the text race in PostScript. In HP PCL mode, the text speed winner among the HP PCL/PostScript desktop machines was the Mannesmann Tally MT911 PS—although it came in behind the PCL-only IBM LaserPrinter 10.

On graphics, the Microtek TrueLaser beat all the printers that came standard with PostScript, but the optional IBM Corp./Lexmark Adobe PostScript cartridge was even faster. In PCL mode, the PCL/PostScript-capable Okidata OL830 led the competition, including the PCL-only printers, on our graphics speed test.

WHAT THE NUMBERS MEAN

Of the 35 desktop laser printers we reviewed this year, only 5 lacked PostScript compatibility as either a standard or an optional feature. For 23 of them, PostScript compatibility came standard, and 16 of those also came standard with PCL. For all the printers that came standard with both emulations, we ran both test suites.

TEXT RESULTS

Among the 23 printers that came standard with PostScript, the Panasonic KX-P4455 Laser Partner, which uses Adobe PostScript and the 11-page-per-minute Panasonic engine, finished in first place on our text speed test by printing 10.2 ppm. In PCL mode, its text speed was slower, at 8.6 ppm.

The PostScript/PCL printer that performed best on the PCL text speed test was the Mannesmann Tally MT911 PS, which uses a 10-ppm Konica LP3110 engine and turned in a text speed of 9.0 ppm. (It was still slower than the fastest PCL-only desktop printer, the IBM LaserPrinter 10, which printed 9.1 ppm on our PCL text speed test. See the PCL-only desktop laser printer test results.) Using the Microsoft Interpreter, the MT911 PS also did very well on our PostScript text speed test, coming in second by generating 8.9 ppm.

The Sharp JX-9500PS, which uses a 6-ppm Sharp JX-95 engine and comes standard with Adobe PostScript and PCL 4, surpassed its rated speed. It whipped through our text speed tests at 6.5 ppm in PostScript and PCL modes.

The 4-ppm printers all performed between 3.7 and 4.2 ppm in PostScript text mode. The LaserMaster TrueTech 800/4, using the Canon LX engine and the Microsoft TrueImage PostScript interpreter, was the slowest. The GCC BLP II, using the Oki Electric OL-400 LED array engine and Adobe PostScript, was the fastest.

GRAPHICS RESULTS

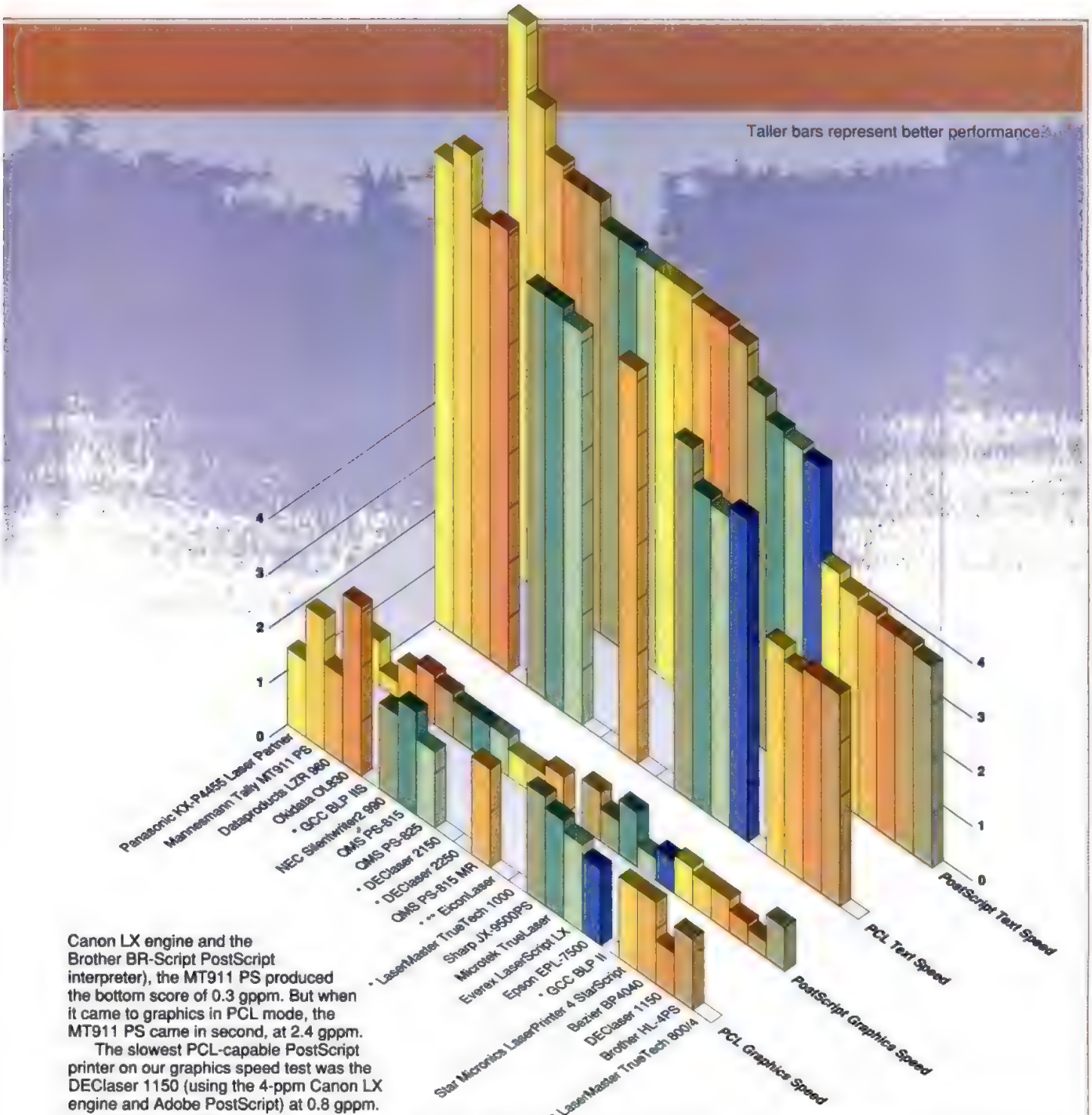
In graphics mode, the PostScript scores are significantly slower than the PCL scores, in part because our test file is larger in PostScript than in PCL.

Among the desktop laser printers that came with PostScript compatibility as a standard feature, the Microtek TrueLaser, which uses a 6-ppm TEC 1305-Z engine and the Microsoft TrueImage PostScript interpreter, came in first place on graphics by printing 1.0 gppm. (From supplemental testing, we have found that the IBM LaserPrinter 10 with its optional Adobe PostScript cartridge beat this score, producing a graphics speed of 1.2 gppm when using a resolution of 300 dots per inch.)

Two printers tied for second on the graphics speed test: the Okidata OL830 (which uses the 8-ppm Okidata LED engine and Adobe PostScript) and the LaserMaster TrueTech 1000 (which uses the 8-ppm Canon SX engine and the Microsoft TrueImage PostScript interpreter). Each delivered a score of 0.9 gppm.

In PCL mode, the Okidata took first-place honors on the graphics speed test, with a score of 3.1 gppm—beating all the desktop laser printers we have ever tested in PCL graphics mode.

Although speedy in PostScript text, the Mannesmann Tally MT911 PS tied for last place on our PostScript graphics speed test. Along with the Brother HL-4PS (which uses the 4-ppm



Canon LX engine and the Brother BR-Script PostScript interpreter), the MT911 PS produced the bottom score of 0.3 gppm. But when it came to graphics in PCL mode, the MT911 PS came in second, at 2.4 gppm.

The slowest PCL-capable PostScript printer on our graphics speed test was the DEClaser 1150 (using the 4-ppm Canon LX engine and Adobe PostScript) at 0.8 gppm. The Brother HL-4PS was the second-slowest printer, at 1.3 gppm.

The EiconLaser, which combines an 8-ppm Canon SX—based laser printer with a PC controller that has the EiconScript PostScript interpreter on-board, was unable to perform our PostScript graphics speed test. But with a utility provided by Eicon Technology Corp., the EiconLaser printed the graphics file at approximately 1.2 gppm, timed by hand.

The **Text Speed** test measures the time it takes to send and print ten copies of a two-page business letter with 1-inch margins in 10-cpi type. Results are reported in pages per minute.

The **Graphics Speed** test measures the time it takes to send and print two copies of a graphics image created by using *PageMaker* and *Microsoft Windows*. Results are reported in graphics pages per minute.

* The tested configuration of this product does not include a PCL mode.
** This product could not complete the PostScript Graphics Speed test.

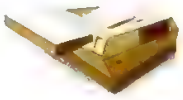
FACT FILE

Eastman Kodak Co., Printer Products Division, 901 Elmgrove Rd., Rochester, NY 14653-6224; 800-344-0006.
Eastman Kodak Ektaplus 7008
List Price: $1,395; 1MB RAM upgrade, $250.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 9 x 15 x 16 inches.
Weight: 38 lbs.
Emulations: HPGL, HP PCL 4.

CIRCLE 425 ON READER SERVICE CARD

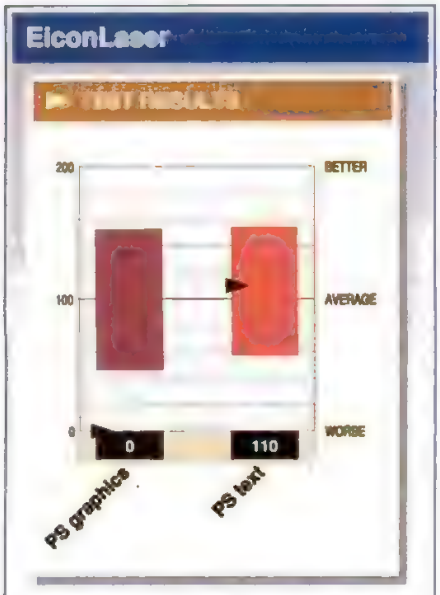
EICON TECHNOLOGY CORP.

EiconLaser



by Mario Baldasserini

The $5,595 EiconLaser starts with a basic 8-page-per-minute Canon SX engine and adds a PC controller with a RISC processor on-board, as well as the EiconScript PostScript interpreter. The high price and inconvenience buy you resolutions as high as 800 by 400 dots per inch.



PostScript scores

In Short: The EiconLaser is a Canon SX engine–based printer with a PC controller that has a RISC processor and EiconScript PostScript emulation on-board. The result is 800- by 400-dpi output, but at a hefty $5,595.

The EiconLaser was not able to run our PCL graphics test.

This high-end printer, with 5MB of RAM, supports resolutions of 400 by 400 dpi and also 800 by 400 dpi. If you want only the lower resolution, you can get a 3MB unit for $5,195. And if you already own a Canon SX–, CX–, or LBP series–based laser printer, you can buy just the EiconScript 300 controller for $1,895 ($1,995 for HP LaserJet II and LaserJet III machines), which takes over your printer's controller and provides a resolution of 600 by 300 dpi and PostScript compatibility.

HIGH-RESOLUTION CONTROLLER

The EiconScript controller uses the Intel 80960 RISC-based graphics processor, running at 25 MHz to speed you through the PostScript translation process. The printer achieves 800 by 400 dpi by using a full frame buffer to map a bit for every corresponding bit in memory.

The EiconScript fits into an expansion slot in your PC; the card connects to the EiconLaser via a 37-pin video interface (the company supplies the cable). Before you can start printing, you must install the configuration software on your host machine. The procedure is easy, and once you complete it, you can set up the board by selecting the I/O port address, the memory window, the interrupt-request level, and the printer resolution.

The software also includes 50 printer fonts, which are stored on your hard disk. Along with the PostScript emulation, the

PERFORMANCE TESTS: PCL-ONLY DESKTOP LASER PRINTERS

IBM Corp./Lexmark was the undisputed leader in the HP PCL competition. Not only did the three printers from this company perform close to their rated speeds, the IBM LaserPrinter 10 was the fastest of all the HP PCL printers on our text speed test. And though the Brother HL-8V placed first on PCL graphics, the IBM trio was very close behind.

WHAT THE NUMBERS MEAN

Of the 35 desktop laser printers in this roundup, 12 come standard with PCL only.

TEXT RESULTS

The fastest desktop laser printer in PCL text mode was the IBM LaserPrinter 10, which produced 9.1 ppm with its 10-ppm IBM/Lexmark engine.

Closely following the IBM LaserPrinter 10 was the Sharp JX-9500H, which uses the 9-ppm Sharp JX-95 engine; it turned in 8.5 ppm on our PCL text speed test.

Two well-engineered printers were actually faster than their rated 6-ppm speed: the Mannesmann Tally MT735 (which uses the 6-ppm Mannesmann Tally 735 thermal engine) produced 6.3 ppm, and the Tandy LP 950 (which uses a 6-ppm Sharp JX-95 laser engine) printed 6.2 ppm.

The 4-ppm printers all ran at their rated text speed: The C. Itoh ProWriter CI-4 (which uses the TEC 1321C laser engine), the HP LaserJet IIIP (which uses the Canon LX laser engine), and the Star Micronics LaserPrinter 4 (which uses the Canon LX laser engine).

GRAPHICS RESULTS

At 2.8 gppm, the Brother HL-8V, which uses the 8-ppm Canon SX laser engine, was the fastest PCL-only graphics printer. (The Okidata OL830, which is a PCL/PostScript printer, produced the fastest graphics score we have ever seen from a desktop laser printer: 3.1 gppm. See the results for PostScript-compatible desktop laser printers.)

In the PCL-only group, the three IBM/Lexmark printers followed closely behind the Brother HL-8V: the LaserPrinter 10 turned in a score of 2.6 gppm, the LaserPrinter 5e produced 2.4 gppm, and the LaserPrinter 6 printed 2.3 gppm. (We were also very impressed by the LaserPrinter 10 with its optional PostScript cartridge installed. In supplemental testing, we discovered that it beat the graphics scores of the desktop laser printers that came with PostScript as a standard feature.)

The Tandy LP 950 surpassed its engine speed in text, but it fared badly in graphics mode. It was the slowest PCL-only printer in graphics mode, printing only 1.3 gppm.

The **Text Speed** test measures the time it takes to send and print ten copies of a two-page business letter with 1-inch margins in 10-cpi type. Results are reported in pages per minute.

The **Graphics Speed** test measures the time it takes to send and print two copies of a graphics image created by using *PageMaker* and *Microsoft Windows*. Results are reported in graphics pages per minute.

EiconLaser

fonts are downloaded to the printer. Using Version 3.3 of the software, the EiconScript had difficulty copying large files to the LPT1 port. This problem is corrected in Version 3.4, which was still in beta stage when PC Magazine Labs tested it. The Version 3.4 upgrade should be available by press time, as should a PCL 5 emulation.

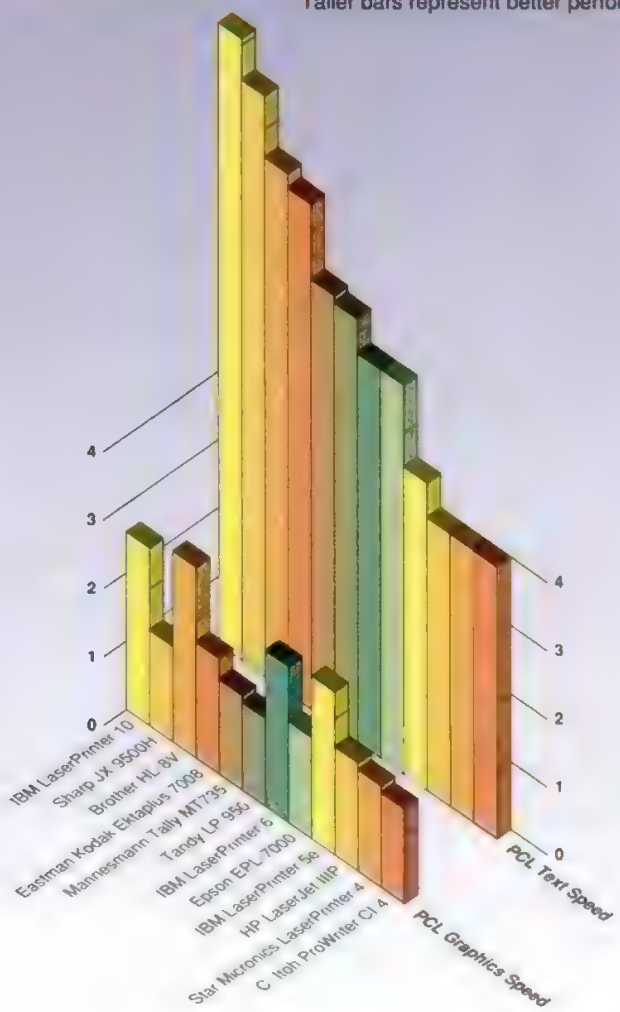
GETTING RESULTS

The EiconLaser was unable to perform our graphics speed test because its controller could not handle the size of our graphics test file (over 700K) without a utility provided by Eicon. With the utility, we were able to print the graphics test file. On hand-timed tests, it scored approximately 1.2 graphics pages per minute—as fast at IBM Corp./Lexmark's Adobe PostScript cartridge, which is the fastest PostScript PC Labs has ever tested. Text speed was unremarkable, at 7.3 ppm.

We were impressed by the 400- by 400-dpi graphics output. It was well defined and retained the shading characteristics of the scanned photograph. Although dots were still visible, the output marked a definite improvement over 300-dpi PostScript output from other printers. Regarding 800 by 400 mode, however, we were less enthusiastic. The scanned image looked smooth and sharp around the edges, but the printer handled shading poorly; the image was very dark and lacked clarity. Both configurations produced excellent text quality.

Compared with high-resolution offerings from IBM/Lexmark and LaserMaster Technologies Corp., the EiconLaser falls short. But for current HP LaserJet owners, the EiconScript controller may offer a welcome boost in resolution.

Taller bars represent better performance.



FACT FILE

Eicon Technology Corp., 2196 32nd Ave., Montreal, Quebec, Canada H8T 3H7; 514-631-2592.

EiconLaser

List Price: $5,595; 1MB RAM upgrade, $250; 2MB RAM upgrade, $450; 3MB RAM upgrade, $650; HP PCL 5 emulation, $300.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 9 x 18 x 32 inches.

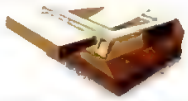
Weight: 42 lbs.

Emulations: EiconScript PostScript interpreter.

CIRCLE **426** ON READER SERVICE CARD

EPSON AMERICA INC.

Epson EPL-7000
Epson EPL-7500

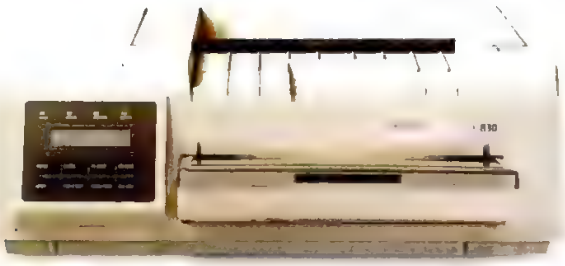


by Bruce Brown

The last time we included Epson America in a comparative laser printer review, the company's entry was a $1,499 6-page-per-minute laser printer based on the TEC engine. It was called the Epson EPL-6000, and it had a list price of $1,499 18 months ago ("A $1,000 Laser for Every Desktop," *PC Magazine*, June 12, 1990). Since then, Epson has replaced the EPL-6000 with two new printers: the EPL-7000 and the EPL-7500. They both use the 6-ppm Minolta SP-101 engine, which gives them higher-quality output than the TEC engine gave their predecessor.

The $1,399 EPL-7000 includes Epson

The new OL830 had to be smarter than the LaserJet® III to earn the Okidata OK!™



Smart.

- **Smart price: $1999.00***
- Gives you the best font scaling and graphic output from over 5000 different software applications.
- Offers 17 scalable plus 26 bitmapped fonts, standard.
- 2 megabytes of memory for full-page graphics.
- Optional second paper tray for second sheets, alternate letterhead.
- 5-year printhead warranty. (Plus 1 year parts/labor on entire printer.)

Not So Smart.

- **Not-so-smart price: $2395.00***
- Only supports font scaling and graphics from a few hundred software applications without expensive brain surgery.
- The best it can manage without costly add-ons is 8 scalable and 14 bitmapped fonts.
- 1 meg is all you get, standard. Can't even remember one full page of graphics.
- No place to add a second tray. You're stuck with only one kind of paper at a time.
- Standard 1-year warranty. Not so smart.

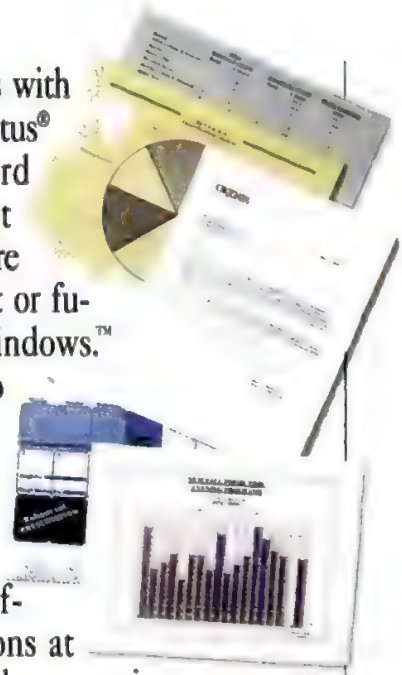
If you think buying the smartest 8 page-per-minute business printer is a smart business move, we think you'll agree Okidata's new OL830 is a stroke of pure genius.

It Takes Brains To Make A Smart Printer.

Okidata's newest printer takes just about every important feature of the LaserJet III and adds an IQ boost all its own. The OL830 offers more typefaces and fonts for better-looking documents, and more standard memory for full-page graphics. An optional second paper tray fits underneath to switch between letterhead and second sheet, or plain paper and envelopes, without reloading. And the OL830's 5-year printhead warranty is the longest in the industry. All for a suggested retail price that's hundreds of dollars less than the LaserJet III.

So Smart, It Already Knows Your Software.

To give our smart printer even more smarts, we include Printer Control Panel™ autoswitching software from LaserTools®–a $149 value. By switching automatically between *both* major printer emulations (Adobe's® PostScript® *and* HP® LaserJet), the OL830 will deliver superb output and dazzling graphics with WordPerfect,® Lotus® 1-2-3,® Harvard Graphics,® or just about any software package, present or future, DOS or Windows.™ Since it's also fully Novell® network-compatible, users on a LAN can send output from different applications at any time without printer headaches.



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*Manufacturer's suggested retail price. Dealer prices may vary. HP and LaserJet are Reg. T.M.'s of Hewlett Packard Inc. Adobe and PostScript are Reg. T.M.'s of Adobe Systems Inc. Printer Control Panel is a T.M. and LaserTools is a Reg. T.M. of LaserTools Corp. WordPerfect is a Reg. T.M. of WordPerfect Corp. Lotus and 1-2-3 are Reg. T.M.'s of Lotus Development Corp. Harvard Graphics is a Reg. T.M. of Software Publishing Corp. Windows is a T.M. of Microsoft Corp. Okidata is a Reg. T.M. and Okidata OK! is a T.M. of OKI Electric Industry Co., LTD. "We don't just design it to work. We design it to work wonders." is a T.M. of OKI America Inc.

CIRCLE 235 ON READER SERVICE CARD

FX, Epson LQ, and HP PCL 4 emulations, and it features simultaneously active ports and automatic interface switching. The $2,999 EPL-7500 has both more and less than its sibling. It adds Adobe PostScript, 1.5MB of RAM, and a Weitek XL8200 RISC processor, but it takes away the printer-sharing features. With a street price around $800, the EPL-7000 is an attractive value. Available for roughly $2,000, the EPL-7500, which has less fonts and no printer-sharing capabilities, is less wallet-tempting.

> *The Minolta engine offers a couple of advantages over the TEC engine. Its output is superior: The blacks are blacker, and the edges are crisper.*

MINOLTA ENGINE

The Minolta engine offers a couple of advantages over the TEC engine. Its output is superior: The blacks are blacker, and the edges are crisper. Also, the printer's standard paper cassette holds more: 250 sheets, compared with 150 sheets. The 250-sheet input cassette is adjustable for most common paper sizes and accommodates legal-size paper. An optional 250-sheet bottom paper cassette ($275) lets you access second sheets. Paper output is collated face-down or face-up; without the $99 optional face-up output tray, however, the paper just falls out of the back of the printer.

In terms of speed, the Minolta-based EPL-7000 equalled the TEC-based EPL-6000's score of 5.7 ppm on PC Magazine Labs' text speed test. Although based on the same engine as the EPL-7000, the EPL-7500 was faster than its sibling because it has a on-board RISC processor. It brought home a speed of 5.9 ppm in both PCL and PostScript text modes.

In graphics, both new printers beat their forebear. The EPL-7000 handled our graphics speed test by printing 1.5 graphics pages per minute in PCL mode (compared with the EPL-6000's score of 1.1 gppm). The EPL-7500 produced 1.4 gppm in PCL mode and 0.6 gppm in PostScript mode.

THE BETTER BUY

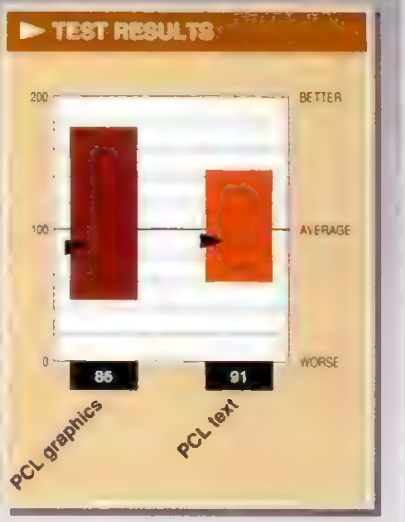
Despite its RISC processor and Adobe PostScript, the EPL-7500 lacks some features that the EPL-7000 has.

Although the EPL-7500 comes standard with a parallel, a serial, and an AppleTalk port, only one interface can be active at a time. The EPL-7000, on the other hand, has simultaneously active ports as well as automatic interface switching, which lets two users share the printer conveniently. Consider adding memory, particularly if you plan to use this feature, because the EPL-7000 comes standard with only 512K of RAM, which is expandable to 2MB by using common memory chips. If you want more memory for separate printer buffers, additional memory cards let you upgrade to a total of 4MB. But at $149 for 512K and $449 for 2MB, the boards are somewhat expensive. (The EPL-7500 comes with 2MB and can be upgraded with a $449 2MB board and a $899 4MB board.) The shared-printer features of the EPL-7000 are impressive nonetheless, especially for a machine sold at such a low price.

Another area in which the EPL-7500 pales in comparison with its less powerful sibling is in the font department. Epson bundles Dataproducts Corp.'s HP-compatible 65-in-One font cartridge with the EPL-7000 but not with the EPL-7500. Furthermore, the EPL-7500 does not accept HP-compatible font cartridges. At press time, there was no path to PostScript for the EPL-7000, but Epson planned to deliver an Adobe PostScript cartridge later this fall.

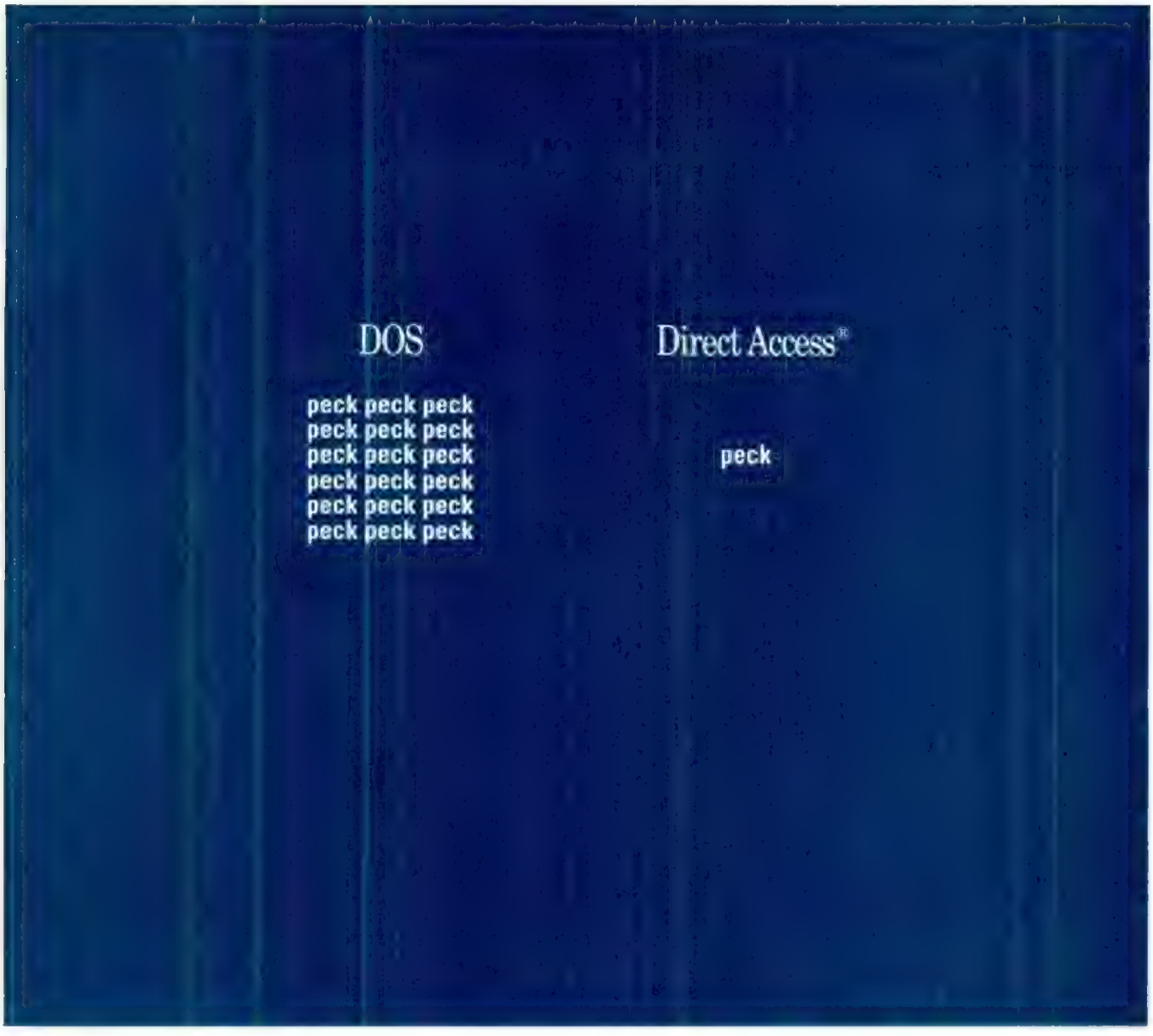
With simultaneous printer sharing, lots of fonts, and a terrific price, the EPL-7000 is a tough competitor in the personal-laser printer market. The EPL-7500 is also a respectable if less interesting choice. Although it is faster than the EPL-7000 and includes Adobe PostScript, nothing special makes it stand out. The EPL-7500 could be improved by gaining the printer-sharing features of its less powerful sibling, as well as the extra fonts.

Epson EPL-7000



PCL scores

In Short: With a street price around $800, the Epson EPL-7000 is a terrific value. Based on the 6-ppm Minolta engine, it provides HP PCL 4 and Epson FX/LQ compatibility, simultaneously active ports, crisp output, and a 65-font HP-compatible font cartridge.



Compared to a menu program like this, everything else is for the birds.

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PC Magazine's Editor's Choice

CIRCLE 288 ON READER SERVICE CARD

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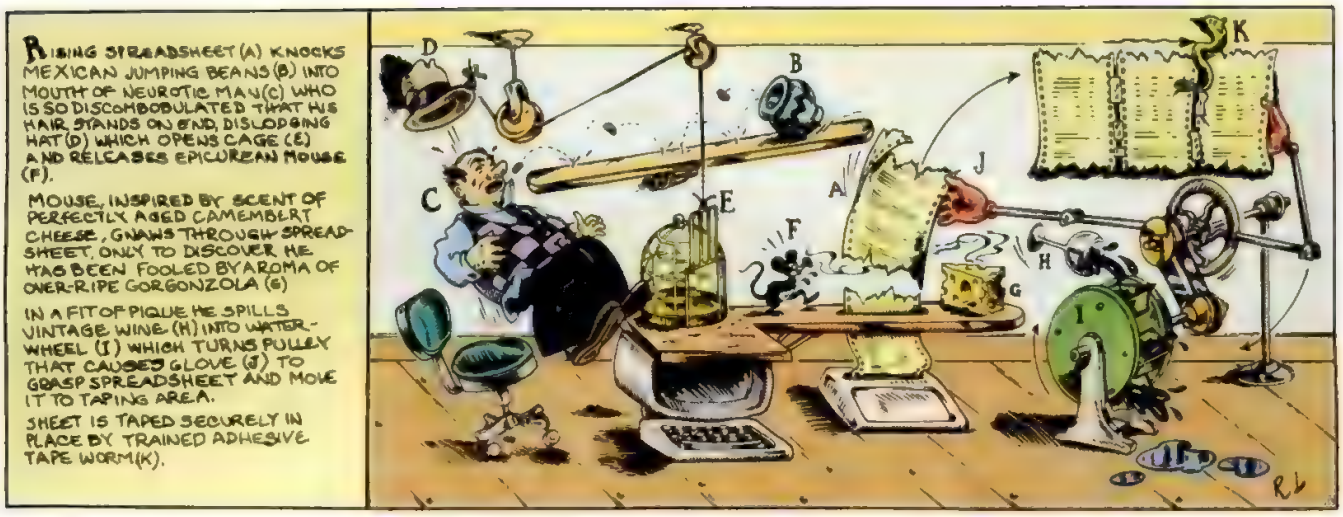

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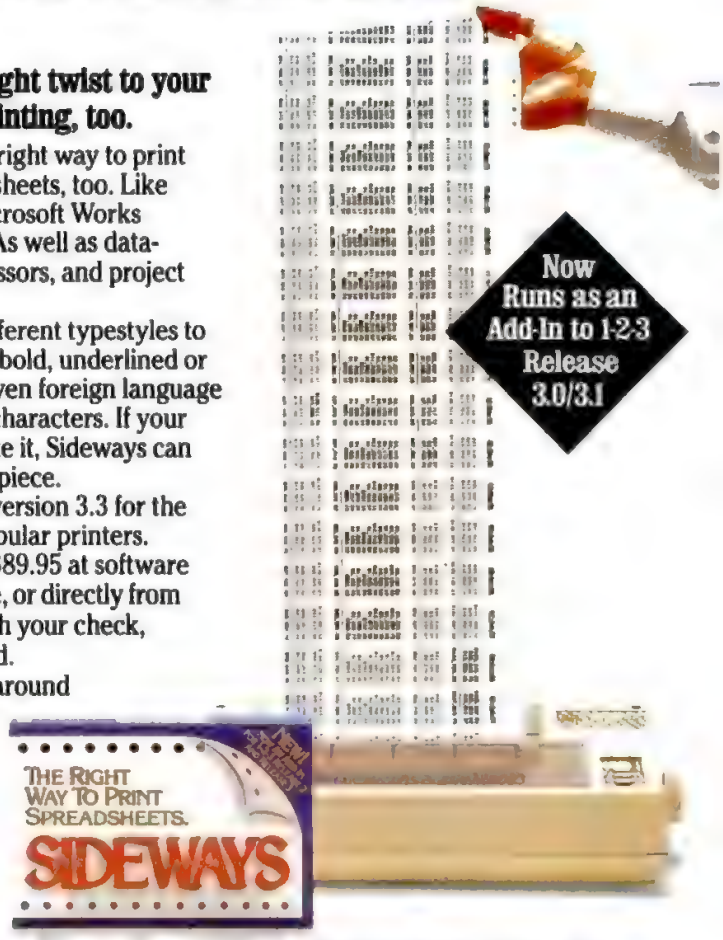

FUNK SOFT WARE

Funk Software, Inc., 222 Third Street, Cambridge, MA 02142

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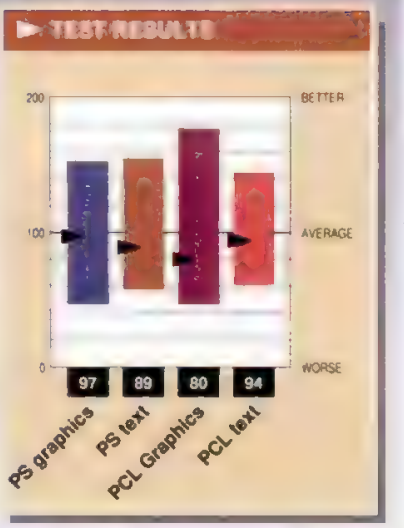
CIRCLE 323 ON READER SERVICE CARD

Epson EPL-7500



PCL and PostScript scores

In Short: The $2,999 Epson EPL-7500 improves on the EPL-7000 by adding a RISC processor and Adobe PostScript. But without the printer-sharing capabilities and the extra fonts, it is less appealing than its sibling. Faster, less expensive PostScript printers are available.

FACT FILE

Epson America Inc., 20770 Madrona Ave., Torrance, CA 90503; 800-922-8911; 213-782-0770.

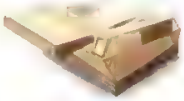
Epson EPL-7000
List Price: $1,399; 512K RAM upgrade, $149; 2MB RAM upgrade, $449; HPGL, $299; bottom letter-size paper cassette, $275; face-up output tray, $99; replacement ozone filter, $18; upgrade kit (to EPL-7500), $2,220.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 8 x 20 x 25 inches.
Weight: 40 lbs.
Emulations: Epson FX/LQ, HP PCL 4.

Epson EPL-7500
List Price: $2,999; 2MB RAM upgrade, $449; 4MB RAM upgrade, $899; bottom letter-size paper cassette, $275; face-up output tray, $99; replacement ozone filter, $18.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 8 x 20 x 25 inches.
Weight: 40 lbs.
Emulations: Adobe PostScript, HP PCL 4.

CIRCLE 428 ON READER SERVICE CARD

EVEREX SYSTEMS INC.

Everex LaserScript LX



by Joseph Desposito

At $1,995, the Everex LaserScript LX is one of five PostScript-compatible laser printers reviewed in this roundup that crack the $2,000 list-price barrier. Based on a 6-page-per-minute TEC engine, the LaserScript LX is admittedly not the fastest of these sub-$2,000 PostScript printers, but with automatic emulation switching between HP PCL 4 and the Microsoft Interpreter PostScript emulator, the LaserScript LX is certainly a solid low-end competitor. And with automatic interface switching among four ports (one parallel, two serial, and one AppleTalk), it is well suited for small workgroups.

Also interesting is Everex Systems' forthcoming $3,295 LaserScript FAX, which is the LaserScript LX with faxing capabilities. Note that you will not be able to upgrade the LaserScript LX to this model. The fax software was still in the beta stage, so we were unable to review it.

BETTER THAN LAST YEAR

The new LaserScript LX from Everex is faster than the Everex Abaton LaserScript, which we reviewed in last year's printer issue. (Abaton is the name of Everex's wholly owned subsidiary, which sells the LaserScript line of products.) The LaserScript of last year used a 15-MHz National Semiconductor Corp. chip, whereas the LaserScript LX uses National Semiconductor's 25-MHz processor and a 32-bit floating-point accelerator. We saw a slight improvement in its performance on our test suite; the LaserScript LX scored 6.0 pages per minute in PostScript text mode, 5.7 ppm in PCL text mode, 0.4 graphics pages per minute in PostScript graphics mode, and 1.6 gppm in PCL graphics mode.

The Everex LaserScript LX produced good print quality. And with the Microsoft Interpreter, you get 35 resident Bitstream fonts. But if you want to use HP-compatible font cartridges, you will have to purchase the $160 option, which enables the two slots.

HOT PORTS

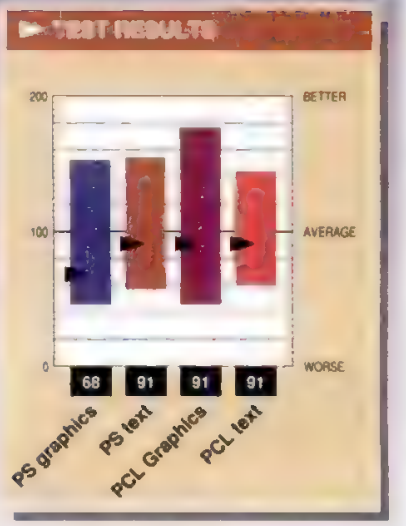
Two of the most appealing and convenient features of the Everex LaserScript

• Everex LaserScript LX

LX are "hot" I/O ports and emulation sensing. The machine has four I/O ports (a parallel, two serial, and an AppleTalk port). The printer senses which I/O port is receiving data and automatically switches to that particular port without intervention from the user. The LaserScript LX does the same with emulations and knows to switch to either PostScript or PCL 4, as is required by the software. With emulation sensing and hot I/O ports, there is little need to use the printer's 32-character LCD control panel.

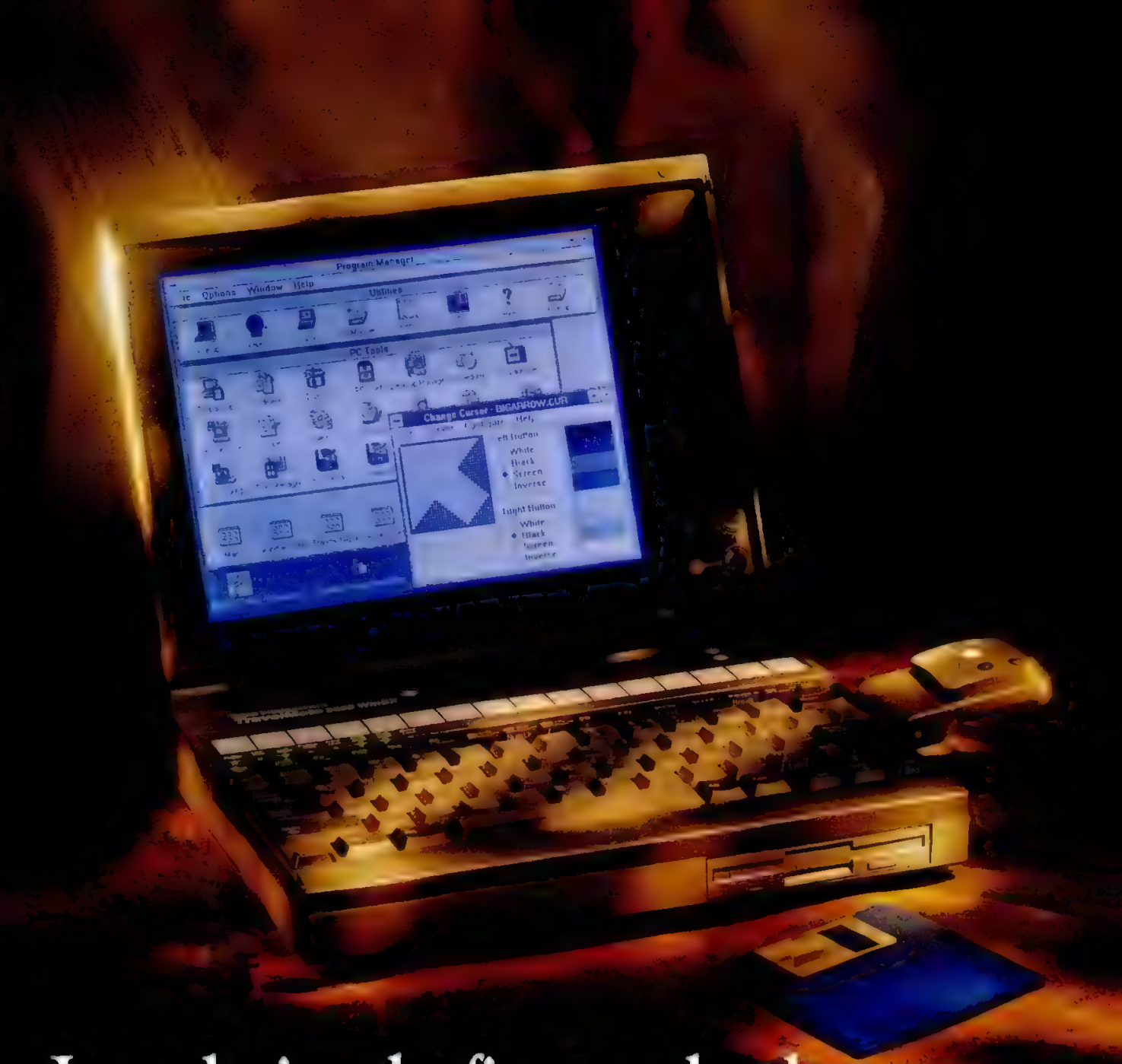
The only area the LaserScript LX did

Everex LaserScript LX



PCL and PostScript scores

In Short: Although not the fastest sub-$2,000 PostScript-compatible printer we have seen, the Everex LaserScript LX is competitively priced. It also provides some attractive features, such as automatic emulation switching between HP PCL 4 and the Microsoft Interpreter PostScript emulator, and automatic interface switching among four ports. This is a good printer for small workgroups.



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CIRCLE 304 ON READER SERVICE CARD

HOW TO IMPROVE WINDOWS PRINTING WITH SOFTWARE AND CLICKS OF THE MOUSE

Tired of waiting for your *Windows* documents to print? Try an inexpensive print spooler, or download a utility from CompuServe.

by Edward Mendelson

No one ever accused *Microsoft Windows* of printing too quickly. However, by selecting some built-in options and installing a few utilities on your own, you can make your *Windows* application print faster, more clearly, and more reliably than it does straight out of the box.

Most *Windows* applications print slowly, but speed problems are not entirely *Windows*' fault. Carefully designed applications such as *PageMaker* can print almost as quickly as character-based DOS applications. Others (*Word for Windows*, for example) seem to take forever to format text and graphics for the printer. Some *Windows* printer drivers are more efficient than others (such as the LaserMaster printer driver, which we found amazingly fast), and better-designed applications adjust their printing to exploit special features of individual drivers.

Until applications improve, we have found that there are many ways to squeeze precious seconds out of *Windows* print times. The inefficient print spooler built into the *Windows* Print Manager is actually an easily removable bottleneck: You should supplement or replace it with LaserTools Corp.'s $149 *PrintCache*, which is really the best print spooler on the market (800-767-8004). *PrintCache*, which works with both DOS and *Windows* applications, sets up a device driver that receives print data at high speed, and this means that you get back to work faster. Depending on the applications that you use, you may get the best results by simultaneously using the *Windows* spooler and *PrintCache* or by turning off the *Windows* spooler and using *PrintCache* only.

LOWER THE RESOLUTION

Windows is a graphics environment, and virtually all printers process graphics more slowly than text. Even if the output from a *Windows* application includes only text and perhaps some vertical and horizontal lines in a table, you may find that printing slows drastically as the printer driver processes the lines as graphical elements. If you use a laser printer and don't print images, set your printer driver's resolution to 150 dots per inch instead of 300 dpi. (You reach this setting through the control panel's Printer Setup menu.) Your text will still print at 300 dpi, but horizontal and vertical lines will print more quickly and with almost no degradation.

For faster and better graphics printing with HP LaserJet printers and most dot matrix printers, you can try Zenographics' $195 *SuperPrint*, Version 2.0 (714-851-6352). *SuperPrint* installs its own replacement printer drivers and supplements them with an advanced spooler that replaces the Print Manager. This combination generally prints graphics in greater detail than the standard drivers can. *SuperPrint* usually prints graphics at better speed. *SuperPrint* also includes the font-scaling abilities of *Adobe Type Manager* and *FaceLift*, but if you print only text, the output is slower than with standard *Windows* drivers.

Windows' HP LaserJet driver incorporates powerful functions for installing and downloading soft fonts. PostScript users, however, have to modify soft-font installation by hand. Furthermore, they must wrestle with the PostScript driver's effective limit of 175 fonts. Until Adobe Systems' new PostScript drivers arrive, you will probably find that the best solution is a copy of *FontManager*, available for downloading from CompuServe's DTP Forum, Library 6. This cleverly designed *Windows* utility lets you install and remove individual fonts or predefined groups of fonts from the *Windows* driver, and you can link it to *WinPSX*, a downloadable *Windows* PostScript program also available from the same source.

You can easily solve other *Windows* printing headaches with a few free utilities and a bit of forethought. Most *Windows* applications force you to use the Control Panel when you want to change from portrait to landscape mode. A small *Windows* program called *Flipper*, available on CompuServe's WINNEW Forum, lets you change the output orientation by clicking on an icon. Fortunately, the latest versions of most advanced *Windows* word processors let you specify orientation within the application itself, so you won't need the Control Panel or *Flipper*.

When you try to print large, complex graphics, *Windows* sometimes gives up and displays an error message that says it cannot print. If you close inactive programs and reduce everything but the active application to icons, you can often free up enough system resources to let the file print.

Of course, if you want better-looking text and an almost infinite range of on-the-fly scalable fonts for almost any *Windows* screen printer, you should definitely rush out and buy a $99 copy of *Adobe Type Manager* now. If you have a collection of Bitstream fonts, you can also get on-the-fly screen and printer fonts with Bitstream's $99 *FaceLift for Microsoft Windows*. And if you have an HP LaserJet III or another HP PCL 5 printer, get matching screen fonts for the printer's built-in scalable fonts with HP's *Intellifont-for-Windows*, which is free for the asking (303-353-7650). ■

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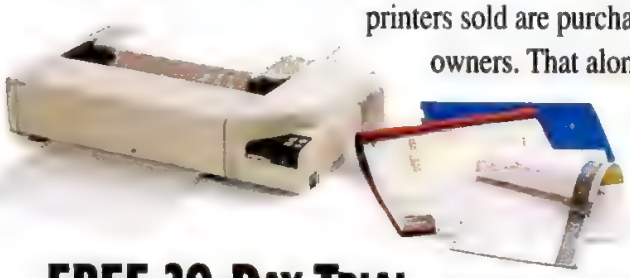

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CIRCLE 245 ON READER SERVICE CARD

not improve on is the standard memory configuration; at 2.5MB, the LaserScript LX has 512K less RAM than its predecessor. You can upgrade memory to a maximum 4.5MB for an additional $200. The three-part TEC engine uses two consumables: toner and drum. Everex sells toner cartridges in pairs for $79, each of which lasts for approximately 1,500 pages. The photoconductor drum, which sells for $150, has a life of approximately 10,000 pages.

A FAXING MODEL

For $1,300 more than the LaserScript LX, you can buy the LaserScript FAX. It's a bit overpriced, but in preliminary testing with the beta software, we found the faxing capabilities convenient and easy to use. The fax software runs under *Microsoft Windows*, so sending a fax is as easy as printing from a *Windows* application. Whenever you print, a dialog box appears; you can either print the document or send a fax. Selecting the fax option brings up a utility called the LaserScript FAX RoadMap. The RoadMap window contains "buttons" that let you enter information for the fax destination and cover sheet, and then it lets you send the fax. You may also use the RoadMap to build a telephone database (compatible with *dBASE III* or *dBASE IV*). Also included with the software is the Everex Fax Manager, designed for sending quick fax memos.

The low price and robust feature set, including the automatic switching among all of its four interfaces and between the two emulations, makes the Everex LaserScript LX a very attractive purchase. As interesting but definitely not as easy on the budget, the Everex LaserScript FAX was easy to use in preliminary tests with beta software.

FACT FILE

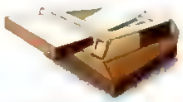
Everex Systems Inc., 48431 Milmont Dr., Fremont, CA 94538; 415-683-2226.
Everex LaserScript LX
List Price: $1,995; 2MB RAM upgrade, $200; HP cartridge support kit, $160.
Standard Warranty: One year on parts and labor, with on-site service the first 90 days.
Dimensions (HWD): 9 x 25 x 16 inches.
Weight: 35 lbs.
Emulations: HP PCL 4, Microsoft Interpreter PostScript interpreter.

CIRCLE 428 ON READER SERVICE CARD

GCC TECHNOLOGIES INC.

GCC BLP II
GCC BLP IIS

by Joseph Desposito



Selling printers for the Macintosh environment since 1987, GCC Technologies is finally making its *PC Magazine* printer-review debut. The 4-page-per-minute GCC BLP II and 8-ppm GCC BLP IIS, which work with PCs and Macintoshes, use Okidata LED engines and Adobe PostScript. Clearly designed more for the Macintosh than the PC, they come with only AppleTalk and SCSI ports. For $149, you can buy the PC Accessories Kit, which includes a parallel and a serial port to replace the standard interfaces.

For PC users, the list prices of both printers are misleading. With a $1,999 price tag, the 4-ppm BLP II has the distinction of being one of only five reviewed PostScript-compatible laser printers with list prices below $2,000, but it is the only one to lack HP PCL 4 emulation as a standard feature. The 8-ppm BLP IIS lists for $2,899. With street prices estimated at only $100 less than their list prices, and because you will have to pay extra for components you would expect to come standard ($149 for the PCL 4 emulation and $149 for the PC Accessories Kit with a parallel and a serial interface), these GCC printers may not have an easy time entering the PC marketplace.

OKI ELECTRIC ENGINES

The BLP II and BLP IIS are identical in appearance to Okidata OL800–series printers and OL400 page printers. While Okidata manufactured the house and engine, GCC designs its own controller boards and feature sets. These GCC printers can use font cartridges designed for Okidata printers.

You can connect either printer directly to a hard disk through its SCSI port for additional font storage. This feature enables GCC to target companies that have extensive font requirements. Keep in mind that if you want the optional parallel or serial ports, you will have to give up the AppleTalk and SCSI ports.

The documentation is good but definitely aimed at Macintosh users. Documentation for PC users is included in the PC Accessories Kit, which contains a parallel-port card, a serial-port card, a cable, and software.

Aside from engine speed, the major difference between the BLP II and BLP IIS concerns the duty cycle and durability. The BLP II's duty cycle is rated at 3,000 pages per month and its durability at 180,000 pages; the BLP IIS's duty cycle is rated at 5,000 pages per month and its durability at 300,000 pages.

TEST RESULTS

On our speed tests, both printers did well. The BLP II exceeded its rated speed on the text speed test, for which it produced 4.2 pages per minute when using Adobe PostScript. The BLP IIS also did respectably, bringing in a score of 7.9 ppm. This was faster than Canon SX–based laser printers (the HP LaserJet III, for example, printed 7.5 ppm when we reviewed it last year).

On the graphics speed test, the 4-ppm model did especially well. It printed 0.7 graphics pages per minute—only 0.7 gppm less than its 8-ppm sibling (both printers use the same 16-MHz Motorola 68000 processor).

The duo did not fare as well in terms of output quality. Although they use true Adobe PostScript, they printed our graphics test file erratically, sometimes distorting the image slightly. GCC was unable to explain this problem.

If you work with PCs and Macs connected on an AppleTalk network serving up to five users, consider a GCC printer.

If you are working with PCs and Macs connected together on an AppleTalk network, you should consider a GCC printer, especially if you can benefit from connecting it to a hard disk through the SCSI port. The BLP II can adequately serve small networks (up to five users), and larger networks need the BLP IIS. But for typical PC users, the GCC printers are not recommended. It seems foolhardy to spend $300 extra for the interfaces and PCL 4 emulation that are standard on most other page printers designed for the PC market.

FACT FILE

GCC Technologies Inc., 580 Winter St., Waltham, MA 02154; 800-422-7777, 617-890-0880.

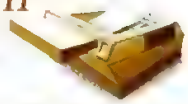
GCC BLP II
List Price: $1,999; 2MB RAM upgrade, $199; HP Emulation Kit, $149; PC Accessories Kit, $149; parallel port, $42; serial port, $42.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 5 x 17 x 23 inches.
Weight: 23 lbs.
Emulations: Adobe PostScript.

GCC BLP IIS
List Price: $2,899; 2MB RAM upgrade, $199; HP Emulation Kit, $149; PC Accessories Kit, $149; parallel port, $42; serial port, $42.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 5 x 17 x 23 inches.
Weight: 23 lbs.
Emulations: Adobe PostScript.

CIRCLE 429 ON READER SERVICE CARD

HEWLETT-PACKARD CO.

HP LaserJet IIIP



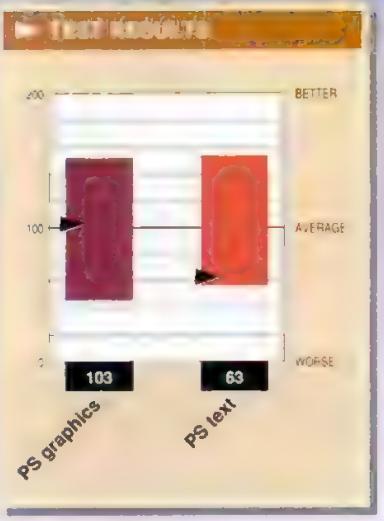
by Edward Mendelson

Hewlett-Packard Co. in effect created the laser printer market when it introduced the original HP LaserJet in 1984. This printer still stands over that market like a colossus. The HP LaserJet III, in the middle of the market range, remains the most popular laser printer ever made. (See last year's printer issue, November 13, 1990, for a complete review.) This year, HP has again solidified its control over the high end of the market, with the 17-page-per-minute HP LaserJet IIISi (reviewed in this issue's section on shared laser printers), and also over the low end, with the 4-ppm HP LaserJet IIIP.

The $1,595 LaserJet IIIP is a stunning achievement—a superb printer rich in features that make it suitable for professional use, but at a street price (typically $1,000 to $1,100) that makes it accessible to almost anyone who can afford a PC.

Among the attractions built into the LaserJet IIIP's compact design are HP's

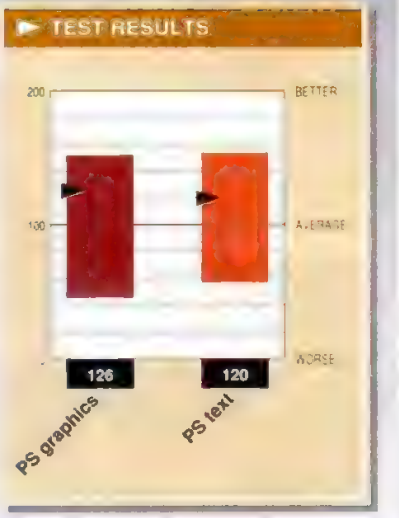
GCC BLP II



PostScript scores

In Short: Based on an Oki Electric LED engine and using Adobe PostScript, the $1,999 GCC BLP II betrays its Macintosh focus. Items that PC users consider standard, such as documentation, a parallel port, and HP PCL 4 emulation, are options. In addition, the unit printed our graphics test file erratically.

GCC BLP IIS



PostScript scores

In Short: The 8-ppm version of the BCC BLP II, the $2,899 GCC BLP IIS shares its sibling's Mac-centrism and problems with our test file.

HP LaserJet IIIP

PCL scores

In Short: The most versatile personal printer available, HP LaserJet IIIP, based on the 4-ppm Canon LX engine, provides HP PCL 5, scalable fonts, and Resolution Enhancement Technology, with a street price hovering around $1,000. You cannot find a better printer in this class.

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HP LaserJet IIIP

Resolution Enhancement Technology (RET), first introduced in the LaserJet III. It gives sharper, cleaner output than almost all rival designs, along with full implementation of the HP PCL 5 printer control language, advanced graphics support, and built-in scalable CG Times and Univers fonts. The LaserJet IIIP's version of PCL 5 is actually a superset of the one in the LaserJet III, but in practice all software will speak to both printers in the same way.

The LaserJet IIIP's standard allotment of 1MB of RAM lets you print three-fourths of a page in graphics; you can boost this to 5MB by using inexpensive add-in boards available anywhere. The printer's one cartridge slot lets you use any font cartridge that works with the LaserJet III—including HP's Adobe-licensed $695 PostScript cartridge (which requires 1MB of additional RAM). HP also offers a single $175 cartridge that gives you Epson FX and IBM Proprinter emulations.

At press time, the LaserJet IIIP's predecessor, the LaserJet IIP (reviewed two years ago), was on the market, priced at $1,295. But HP was readying a replacement called the HP LaserJet IIP Plus, which has a faster processor and a lower list price of $1,249. Like the LaserJet IIP, the LaserJet IIP Plus lacks RET and PCL 5. But it promises to be an excellent printer at an exceptional price.

MORE PAPER, MORE SPEED

With its 70-sheet-capacity paper cassette, the LaserJet IIIP improves on the paper handling of the LaserJet IIP, which could only hold 50 sheets. And if you add the optional 250-sheet bottom paper cassette ($195) for dual-bin printing (but not duplexing), you can easily use the built-in cassette for letterhead paper and the bottom cassette for second sheets, or the built-in cassette for paper and the bottom cassette for envelopes (although to do that, you will need an optional $89 envelope cassette).

On PC Magazine Labs' text speed test, the LaserJet IIIP produced typical results for a printer based on the Canon LX engine: 4 ppm. But the graphics results were impressive for this class of printer. At 1.6 graphics pages per minute on our test, the LaserJet IIIP prints graphics almost as quickly as does the LaserJet III, which performed our test at 1.9 gppm. Part of this impressive performance can be credited to the LaserJet IIIP's 16-MHz Motorola 68000 processor; the LaserJet IIP used a 10-MHz processor. Also contributing to the LaserJet IIIP's speediness is an improved parallel port, which receives data at 55K per second, compared to 10K per second for the LaserJet IIP and 15K per second for the LaserJet III.

The LaserJet IIIP's push-button control panel (with a 16-character LED) is fairly simple to use, but you will probably never have to touch it. Toner cartridges priced at $95 and rated at 3,500 copies are widely available at a discount. You can change cartridges in about 30 seconds.

If the LaserJet IIIP is so good, is there still any reason to buy the LaserJet III? The latter offers 8-ppm text printing (twice the speed of the LaserJet IIIP), two cartridge slots instead of one, and a video interface for add-in boards such as those from LaserMaster. But the LaserJet III also occupies far more real estate on your desktop, and its Canon SX engine produces output slightly less dark and less well defined than the LaserJet IIIP's LX engine. Whichever you choose—the LaserJet IIIP's economies of price and size or the LaserJet III's speed, cartridge capacity, and input options—you will own one of the finest printers ever built.

FACT FILE

Hewlett-Packard Co., 19310 Pruneridge Ave., Cupertino, CA 95014; 800-752-0900.

EDITORS' CHOICE

HP LaserJet IIIP

List Price: $1,595; 1MB RAM upgrade, $230; 2MB RAM upgrade, $390; Adobe PostScript emulation, $695; Epson FX and IBM Proprinter emulations, $175; bottom letter-size paper cassette, $195; second letter-size paper cassette, $69; legal-size paper cassette, $79; executive-size paper cassette, $75; A4-size paper cassette, $69; A4-size bottom paper cassette, $195; envelope cassette, $89; AppleTalk interface kit, $275.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 8 x 14 x 25 inches.

Weight: 22 lbs.

Emulations: HP PCL 5.

CIRCLE 542 ON READER SERVICE CARD

IBM CORP./LEXMARK

IBM LaserPrinter 5e
IBM LaserPrinter 6
IBM LaserPrinter 10

by Bill O'Brien

Lexmark is a new "IBM-alliance company," but think of it as the old Lexington, Kentucky–based division of IBM that brought you the Editors' Choice–winning duo, the IBM LaserPrinter (reviewed two years ago) and the IBM LaserPrinter 10e (reviewed last year). This year, the company has done it again, delivering four laser devices that span the chasm between personal and power printers, providing impressive speeds, true 600-dot-per-inch resolution, improved resolution at 300 dpi, fast Adobe PostScript graphics, and superior paper handling. Many of the best features are options, but all are priced competitively.

FOUR NEW LASERS

IBM Corp./Lexmark's four new entries, based on the new 4029 engine series, are the entry-level 5-page-per-minute $1,595 LaserPrinter 5e, the 6-ppm $1,895 LaserPrinter 6, the 10-ppm $2,395 LaserPrinter 10, and the 10-ppm $2,995 LaserPrinter 10L. The first three are all desktop laser printers; the LaserPrinter 10L adds networking features to the LaserPrinter 10 and is reviewed in the shared laser section of this issue.

No matter which of the three you look at, you will see the same laser engine (in fact, the basic chassis dates back to the 4019 engine used in the IBM LaserPrinter and IBM LaserPrinter 10e). It has IBM's proprietary design, and the power that moves it is the controller card found in each printer. For the LaserPrinter 5e and LaserPrinter 6, that controller is run by a Motorola 68000; for the LaserPrinter 10,

it is a 68020. And the LaserPrinter 10 ships with IBM's higher-capacity 15,000-copy toner cartridge; that's a 50 percent better yield than the cartridge supplied with the LaserPrinter 6.

For a not-so-modest $899, you can replace the existing 6-ppm controller card on the LaserPrinter 6 with the same controller you can find in the LaserPrinter 10; you will lose $399, but it's good to know you can upgrade if you want to. The LaserPrinter 5e does not have this flexibility.

One welcome feature is the addition of an LCD panel, which spells out the various options available from the front control panel. It replaces the cryptic LED code combinations on the 4019-based units.

All three of these desktop laser printers come standard with 1MB of RAM (expandable to 9MB) and four emulations—HPGL, HP PCL 4 (with 12 bitmapped fonts), IBM Graphics Printer, and IBM PPDS (Personal Printer Data Stream, with 10 bitmapped fonts). There are also 16 scalable Adobe Type 1 fonts included in PPDS, and in the box you will find a floppy disk with 17 scalable screen fonts. Both the LaserPrinter 6 and LaserPrinter 10 have two slots for IBM's proprietary font card, while the LaserPrinter 5e has only a single card slot.

GET READY TO UPGRADE

Once you're done with the standard inclusions, be prepared to upgrade. The printers currently have two additional emulations available, Adobe PostScript ($499) and PCL 5 ($199). The LaserPrinter 6 and LaserPrinter 10 can hold both options at the same time, while the LaserPrinter 5e's controller has only a single emulation-card socket. You won't need anything more than the emulation card to have PCL 5 compatibility, but PostScript opens up several other vistas.

The emulation card itself provides only the basic 17 PostScript fonts. You can add an additional 22 fonts with a $399 font cartridge. You also need at least 2MB of RAM to run PostScript, which means you will need a $199 1MB memory upgrade. But you may need even more memory than that if you want to take advantage of another special feature.

TRUE 600 DPI

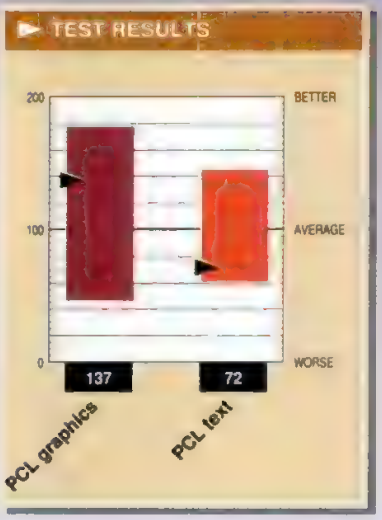
Without PostScript installed, the printers run at 300 dpi. Once you add the PostScript emulation card, if your printer has the maximum 5MB of RAM (via the $799 4MB upgrade), you will find a new menu item on the LaserPrinter 6 and LaserPrinter 10: 600 dpi. Note that you cannot access 600-dpi mode on the LaserPrinter 5e.

That is no misprint. IBM/Lexmark has built a 600-dpi resolution into its printers. This is not any oddball combination of tricks that simulate this high resolution; the laser is actually modulated to produce a smaller dot size and lay down toner in a 600-dpi pattern. You will have to give up some speed: The LaserPrinter 10 drops down to 8 ppm, and the LaserPrinter 6 produces 4.5 ppm, according to IBM/Lexmark. This slowdown gives the laser the time it needs to operate at that resolution, but everything else is handled by the laser and the optics under the controller's guidance.

PQET AND PAPER TOO

Even if you don't want the somewhat expensive 600-dpi option, you will bene-

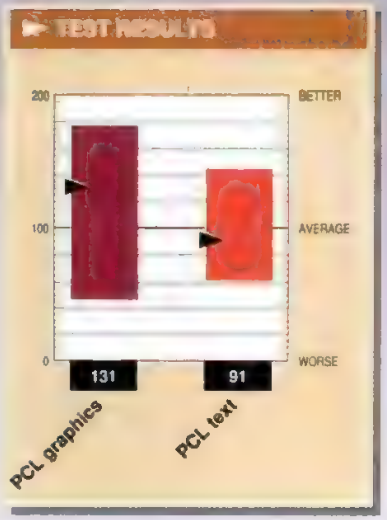
IBM LaserPrinter 5e



PCL scores

In Short: Based on a new model of the engine that won Editors' Choice status for earlier IBM LaserPrinters, the $1,595 IBM LaserPrinter 5e is the least interesting of IBM/Lexmark's new offerings. Although you can add Adobe PostScript to it, you cannot get 600 dpi or a 10-ppm upgrade.

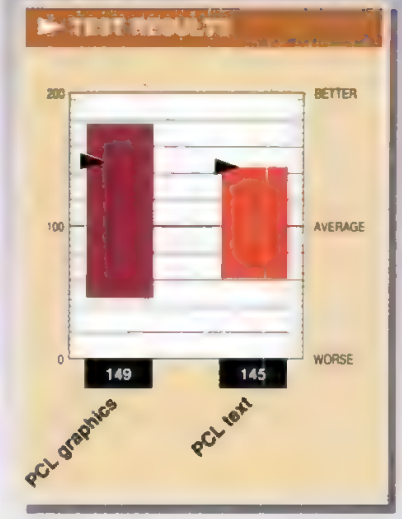
IBM LaserPrinter 6



PCL scores

In Short: A very attractive personal printer, the $1,895 IBM LaserPrinter 6 adds some speed and a second font card to the LaserPrinter 5e. Even more appealing, it provides an Adobe PostScript option that gives you 600-dpi resolution. And if you decide you need more speed, you can upgrade to 10 ppm.

IBM LaserPrinter 10



PCL scores

In Short: With the fastest PCL text score achieved by a desktop laser printer, the $2,395 IBM LaserPrinter 10 is most impressive. Best of all, its Adobe PostScript option provides true 600-dpi output and a PostScript graphics test speed that beat all the printers that included PostScript compatibility.

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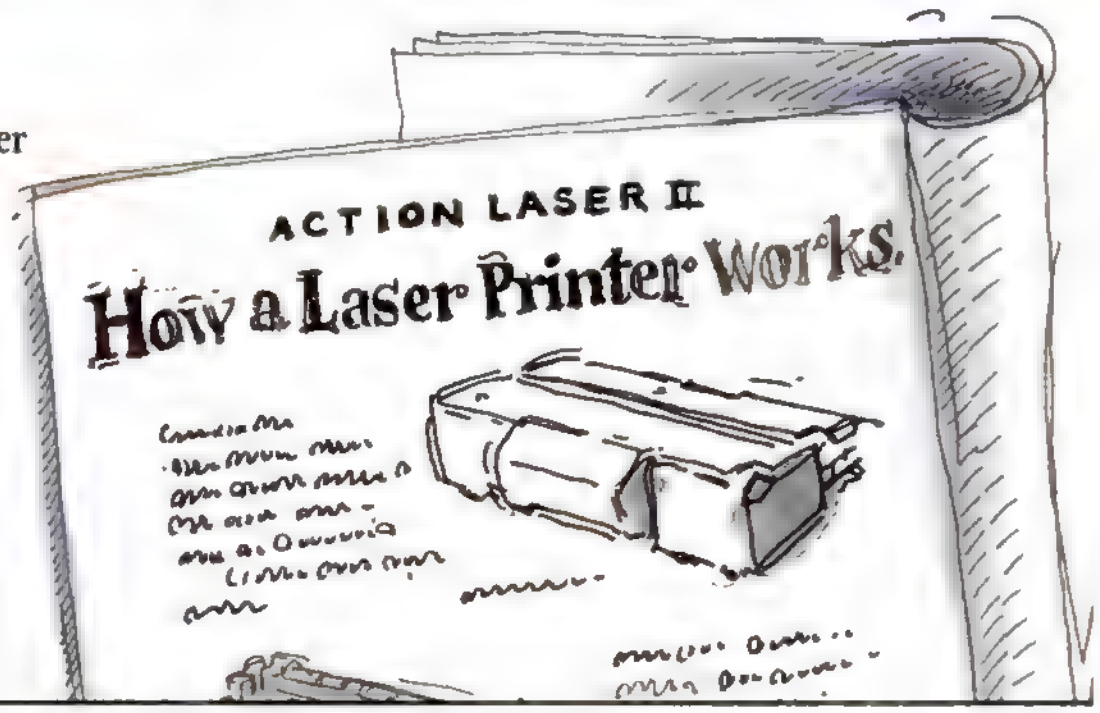

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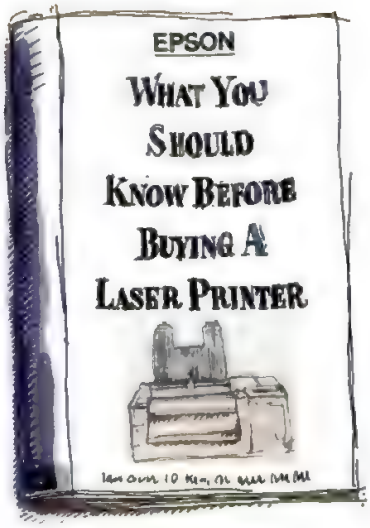

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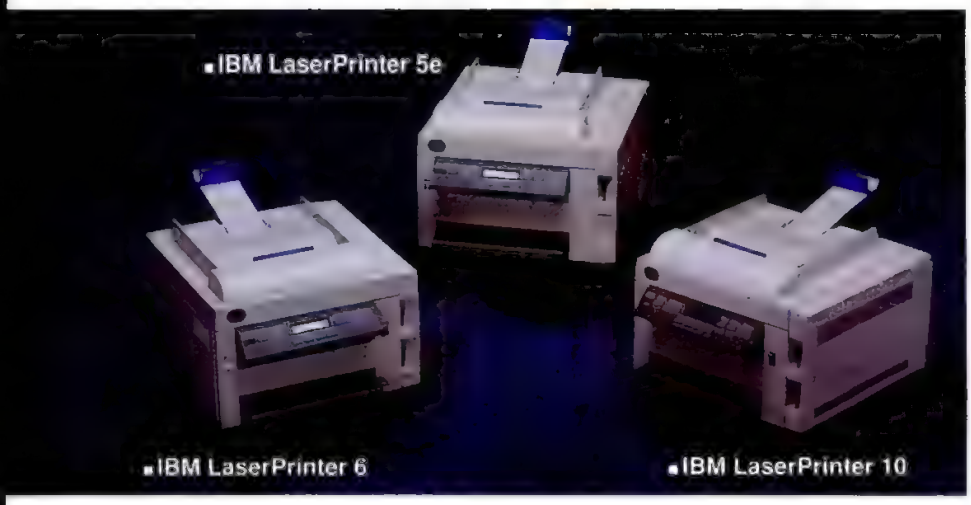

fit from PQET at 300 dpi. This is IBM's Print Quality Enhancement Technology, and it is similar to Hewlett-Packard Co.'s Resolution Enhancement Technology (RET). PQET provides anti-aliasing for the scalable-font technology and does an excellent job in eliminating the jaggies from large and very small type.

The standard paper handling is done through a 200-sheet paper cassette, which feeds paper through an S path and out into a 100-sheet face-down exit tray. The LaserPrinter 6 and LaserPrinter 10 also include a front-mounted face-up tray that reduces the paper travel to a C path for when you need to print on heavier stock. These two models also have an optional 500-sheet bottom-mounted paper drawer ($449) as well as an auxiliary 100-sheet cassette ($279). You can link all paper sources for continuous feed if they all contain the same-size paper.

IBM/Lexmark has paid special attention to the problems of envelope handling on the three printers. There is an optional envelope feeder ($379), but getting an envelope into a laser printer is the simple part of the procedure. Air trapped inside the envelope can cause no end of problems when the envelope is ready to exit through the fuser and pressure rollers. The exit path is the major cause of creasing. The company has engineered a proprietary design to modulate the pressure roller and give the trapped air a chance to escape. As simple as it sounds, the company has applied for a patent on the process.

SOLID SPEEDS

On PC Magazine Labs' speed tests, all three IBM LaserPrinters did well. On our PCL text speed test, the LaserPrinter 10 was the fastest desktop laser we reviewed, delivering a text speed of 9.1 ppm. Its siblings did well in their classes, too, with text speed results of 4.5 and 5.7 for the LaserPrinter 5e and LaserPrinter 6, respectively.

The LaserPrinter 10 also did well on our PCL graphics speed test. With a score of 2.6 gppm, it was one of the faster desktop laser printers in this roundup. The LaserPrinter 5e and LaserPrinter 6 were almost as fast, with scores of 2.4 gppm and 2.3 gppm, respectively.

When we ran the LaserPrinter 10 through our PostScript speed tests (the printer used the optional Adobe PostScript cartridge), we were very impressed with its performance. At 1.2 gppm in 300-dpi mode, the LaserPrinter 10 beat all the desktop laser printers that come standard with PostScript compatibility. Its text speed in PCL mode was 9.1 ppm.

All three desktop laser printers are excellent choices. In comparison with the rest of the IBM/Lexmark product line, the IBM LaserPrinter 5e is not very interesting: It lacks the LaserPrinter 6's face-up exit tray, its optional 600-dpi mode, its second font-card slot, and an upgrade path to the LaserPrinter 10. Also, the LaserPrinter 5e is the slowest of the three. But for home users who don't need the extras, the LaserPrinter 5e is a solid performer. The IBM LaserPrinter 6, with access to all these fancy features, is by contrast a very exciting personal page printer. And the IBM LaserPrinter 10 is in a class by itself, finishing in first place on the PCL text speed test and, when it used its optional Adobe PostScript cartridge, placing first on the PostScript graphics speed test.

FACT FILE

IBM Corp./Lexmark, 740 New Circle Rd., Lexington, KY 40511; 800-426-2468.

IBM LaserPrinter 5e

List Price: $1,595; 1MB RAM upgrade, $199; 2MB RAM upgrade, $399; 4MB RAM upgrade, $799; HP PCL 5 emulation, $199; Adobe PostScript with 17 fonts, $499; additional font cartridges, $399 each; envelope feeder, $379; label/card-stock cassette, $69; AppleTalk interface, $349.

Standard Warranty: One year on parts and labor; on-site coverage available for $330.

Dimensions (HWD): 12 x 14 x 21 inches.

Weight: 33 lbs.

Emulations: HP PCL 4, IBM Graphics Printer, IBM PPDS, IBM Proprinter.

IBM LaserPrinter 6

List Price: $1,895; 1MB RAM upgrade, $199; 2MB RAM upgrade, $399; 4MB RAM upgrade, $799; HP PCL 5 emulation, $199; Adobe PostScript with 17 fonts, $499; additional font cartridges, $399; bottom-mounted letter-size paper cassette, $449; auxiliary letter-size sheet feeder, $279; envelope cassette, $379; label/card-stock cassette, $69; upgrade kit (to LaserPrinter 10), $799; AppleTalk interface, $349.

Standard Warranty: One year on parts and labor; on-site coverage available for $330.

Dimensions (HWD): 12 x 14 x 21 inches.

Weight: 33 lbs.

Emulations: HP PCL 4, IBM Graphics Printer, IBM PPDS, IBM Proprinter.

EDITORS' CHOICE

IBM LaserPrinter 10

List Price: $2,395; 1MB RAM upgrade, $199; 2MB RAM upgrade, $399; 4MB RAM upgrade, $799; HP PCL 5 emulation, $199; Adobe PostScript with 17 fonts, $499; additional font cartridges, $399 each; bottom-mounted letter-size paper cassette, $449; auxiliary letter-size sheet feeder, $279; envelope cassette, $379; label/card-stock cassette, $69; AppleTalk interface, $349.

Standard Warranty: One year on parts and labor; on-site coverage available for $330.

Dimensions: 12 x 14 x 21 inches.

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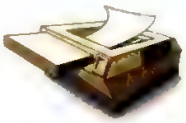
CIRCLE 522 ON READER SERVICE CARD

Weight: 33 lbs.
Emulations: HPGL, HP PCL 4, IBM PPDS, IBM Proprinter.

CIRCLE 543 ON READER SERVICE CARD

LASERMASTER TECHNOLOGIES CORP.

LaserMaster TrueTech 800/4
LaserMaster TrueTech 1000



by Alfred Poor

The two LaserMaster Technologies Corp. printers we review here are quite different from each other, but they are also quite different from almost every other printer reviewed in this issue. While most laser printer manufacturers are content to continue the "near-typeset quality" tradition of 300- by 300-dot-per-inch output, LaserMaster has pushed the technology to higher resolutions.

Unless you are primarily interested in desktop publishing and precision printing, you may not be willing to pay the extra cost for one of these printers. (And given their limited distribution, it is difficult to find them at any significant discount.) But if resolutions of 800 or 1,000 dpi grab your attention, you will want to check out the $3,695 4-ppm LaserMaster TrueTech 800/4, which provides 800-dpi resolution, and the $6,995 8-ppm LaserMaster TrueTech 1000, which offers 1,000-dpi resolution.

TRUETECH = TRUEIMAGE

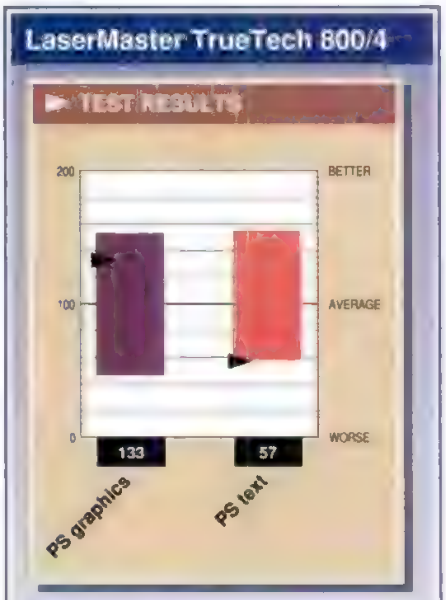
The most important feature of the LaserMaster TrueTech 800/4 and the LaserMaster TrueTech 1000 is represented by the "TrueTech" in their names, which shows that the printers come with the Microsoft TrueImage PostScript interpreter installed. TrueImage is an important step for LaserMaster. In the past, the company's printers only responded to a proprietary printer command language, and as a result required custom drivers for applications such as *Microsoft Windows* and *Ventura Publisher*. This proprietary language limited LaserMaster printers in the PC marketplace and made them impossible to test under the PC Magazine Labs printer test suite.

With the addition of PostScript-compatible TrueImage, however, the high-resolution LaserMaster printers join the mainstream of the PC printer market. Like the proprietary-language models, these too rely on separate controller cards installed in your PC. The card provides a high-speed video interface between the controller and the print engine. The two printers reviewed here have similar but different controller cards, and since each relies on an on-board processor and has plenty of RAM of its own, it places a minimal load on the PC's resources.

800 DPI

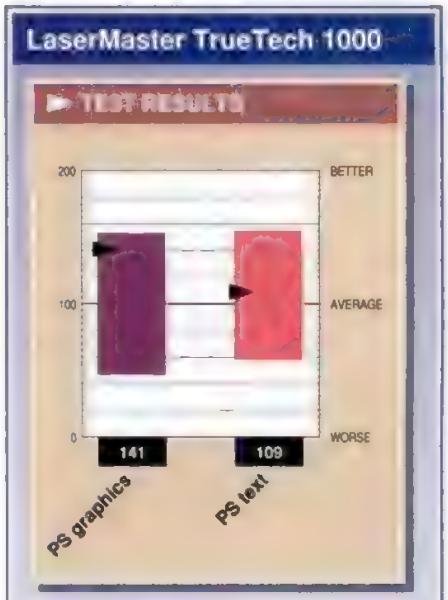
The LaserMaster TrueTech 800/4 lists for $3,695, which is a lot to pay for a 4-ppm printer based on the Canon LX print engine. This price includes the 250-sheet bottom paper cassette, which is optional on almost every other LX-based printer, but that is not where the extra value comes into play. The "800" in its name refers to the 800-dpi resolution it offers.

According to LaserMaster, the print engine is capable of the same 300-dpi



PostScript scores

In Short: In the past, LaserMaster printers have lacked standard PC emulations. But this year, the company has embraced the Microsoft TrueImage PostScript interpreter, entering the mainstream PC marketplace. This 4-ppm Canon LX engine–based printer is not just another clone; at $3,695, it provides 800-dpi output.



PostScript scores

In Short: At $6,995, the 8-ppm Canon SX engine–based LaserMaster TrueTech 1000 is faster and offers even higher resolution than its sibling (1,000 dpi). The extraordinary printouts will be worth the high price for those who need typeset-quality output from a desktop laser printer.

vertical resolution that is typical of a LX-engine printer, but it can produce 800 dpi horizontally. This resolution may be impressive, but for the TrueTech 800/4, this represents only its so-called draft-mode output.

The controller board is able to modulate the energy density of individual pixels, and the printer uses this capability to reach the claimed maximum resolution of 800 by 800 dpi, which the company calls "TurboRes."

While it is difficult to verify the actual resolution produced by a given printer, the results were clearly better, compared with standard 300-dpi images for both text and graphics. The draft mode was only slightly better, but the TurboRes samples were clearly better. Curves were much smoother, and the angled portion of text characters showed far fewer dimples along the edge.

While this resolution comes at a financial price, you don't pay for it in terms of performance. In draft mode, the test speeds rival those of 4-ppm PCL printers: 3.7 ppm for PostScript text, 0.8 graphics pages per minute in graphics. When you kick into TurboRes mode, performance drops only slightly as the output quality goes up dramatically: 3.5 ppm for text and 0.6 gppm for graphics. If you want something a bit faster with the same resolution specifications, LaserMaster offers the $4,995 LaserMaster TrueTech 800, which is based on the 8-ppm Canon SX engine.

The only problem with this printer has to do with the installation procedure. You have to configure the separate adapter card for your computer, and you also must assign it to an LPT port; this meant disabling a motherboard port on our test-bed computer so that the interface could act as LPT1 for our tests. There are separate manuals for the controller and the printer, and they both cover installation and operation but without adequately referencing each other. This adds unnecessary confusion. Overall, however, the printer is an excellent choice for people who want higher-resolution output at a relatively low price.

1,000 DPI

If 800 dpi is not enough, then you might want to consider the LaserMaster TrueTech 1000, with a list price of $6,995. Based on the 8-ppm Canon SX engine,

LASERMASTER WINPRINTER 400: Using Your CPU as a Printer Controller

by Alfred Poor

Ever hear of a printer without a controller? LaserMaster Technologies Corp. has one, and though it was not ready in time to be reviewed for this issue, we had a chance to look at a pre-beta version of it, which is designed for use with *Microsoft Windows*.

The engineers at LaserMaster have been watching PC processors grow faster and more powerful over the years, and they have decided that there are enough extra cycles on today's hot-rod PCs to let them try a new approach. Unlike most printer manufacturers, which put their controllers and print engines in the same housing, LaserMaster has put the controller on a PC expansion card—an approach that has some design advantages, such as faster communication with the computer's CPU, and a faster interface between computer and printer than a standard parallel or serial port can offer. The result is the $1,195 LaserMaster WinPrinter 400, a printer that uses the computer's CPU as a controller.

The printer consists of a Canon LX 4-ppm print engine and a simple 16-bit interface card that goes in a slot in your PC. Unlike most LaserMaster cards, which carry CPUs and lots of RAM, this is a fairly dumb card—no more than a fast interface for the printer. The computer handles all the processing.

The WinPrinter 400 can print at either 300 or 400 dpi and can accept either PostScript or HP PCL 4 code. PCL automatically prints at 300 dpi, but PostScript images can be set for either high or regular resolution. The package includes 50 PostScript font outlines and is compatible with all Type 1 and Type 3 PostScript fonts.

The print quality looks good, and the 400-dot-per-inch PostScript output does a good job of smoothing the jaggies on text and curved graphics. Unfortunately, an incompatibility between the driver and PC Magazine Labs' test suite prevented us from obtaining any performance test results, but the WinPrinter 400 appeared to be adequately fast for a 4-ppm PostScript printer.

The product is designed especially to run with *Microsoft Windows* 3.0, where you can access the different modes from the Printer Selection dialog box. A special version of Print Manager, called *WinPrinter*, offers control over print jobs and the emulations used for each. There is also an animated icon that shows when the *WinPrinter* program is processing a job. You can also access the printer from the DOS prompt, though our tested unit was configured to do this only within a DOS session running under *Windows*.

We did encounter a few problems with the product, but this is to be expected in a unit so early in its development. There were some problems with the PCL 4 emulation, and the controller misidentified some of our PostScript files as PCL 4 files.

Still, the printer worked well enough to show how the concept is intended to work. Given the growing power of desktop CPUs and the interest in *Windows* as a multitasking environment, the LaserMaster WinPrinter 400 promises to provide a new and exciting approach to printing.

LaserMaster Technologies Corp., 7156 Shady Oak Rd., Eden Prairie, MN 55344; 612-944-9330.

LaserMaster WinPrinter 400
List Price: $1,195; bottom-feed paper cassette, $195; A4-size paper cassette, $75; legal-size paper cassette, $75.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 8 x 16 x 14 inches.
Weight: 24 lbs.
Emulations: Microsoft TrueImage PostScript interpreter.

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this printer uses 1,000 by 400 dpi for its draft-mode output and an impressive 1,000 by 1,000 dpi in TurboRes mode. In order to support these higher resolutions, the company also offers special toner cartridges—one specifically formulated for the fine lines required for text, and another designed to handle the large dark areas typically used in graphics images.

The printer has the same installation and documentation drawbacks as the TrueTech 800/4, but this is offset by its high output quality. Draft-mode output is appreciably better than that of 300-dpi printers, while the TurboRes mode removes almost all traces of jaggies, even when you view the output with a 30x microscope.

And as with the TrueTech 800/4, there is little performance penalty for this high resolution. In draft mode, the TrueTech 1000 turned out 7.2 ppm on the PostScript text speed test and 0.9 gppm in graphics mode. In TurboRes mode, these speeds dropped to 6.6 ppm for text and stayed at 0.9 gppm for graphics—only a bit slower than most 300-dpi PostScript printers.

These LaserMaster printers are no bargain if all you need is typical 300-dpi output from a laser printer. But if you create camera-ready output for publication or have some other need for high-resolution output, these two printers may be expensive, but they produce some of the best output in this class.

FACT FILE

LaserMaster Technologies Corp., 7156 Shady Oak Rd., Eden Prairie, MN 55344; 612-944-9330.

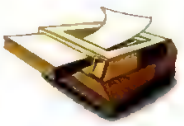
LaserMaster TrueTech 800/4
List Price: $3,695; legal-size paper cassette, $75; A4-size paper cassette, $75.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 9 x 28 x 14 inches.
Weight: 24 lbs.
Emulations: Microsoft TrueImage PostScript interpreter.

LaserMaster TrueTech 1000
List Price: $6,995; legal-size paper cassette, $75; A4-size paper cassette, $75.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 9 x 18 x 26 inches.
Weight: 38 lbs.
Emulations: Microsoft TrueImage PostScript interpreter.

CIRCLE 544 ON READER SERVICE CARD

MANNESMANN TALLY CORP.

Mannesmann Tally MT735
Mannesmann Tally MT911 PS



by Rink Murray

No matter what country you visit, Mannesmann Tally Corp. probably sells printers there. And even if it doesn't, you can now take one with you. That's because the Mannesmann Tally MT735 is the com-

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HXS	4 Serial	Any Combination	256KB - 16MB	Pop-up or Buttons	$295 / 256KB $395 / 1MB
HWP	5 Parallel	3/2 4/1	256KB - 16MB	Pop-up or Buttons	$295 / 256KB $395 / 1MB
HXP	4 Parallel	2/2 3/1	256KB - 16MB	Pop-up or Buttons	$245 / 256KB $345 / 1MB
HCP	2 Parallel	1/1	256KB - 16MB	One Printer	$225 / 256KB $325 / 1MB
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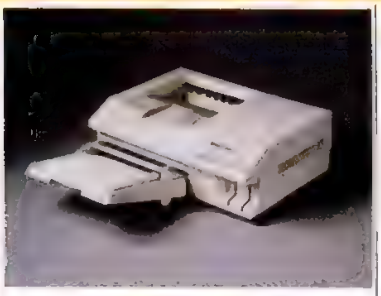

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PR0640	LBP4 Plus Laser Printer 2.0	999.
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NT0150 Lantastic Ethernet Adapter Card ... 225.
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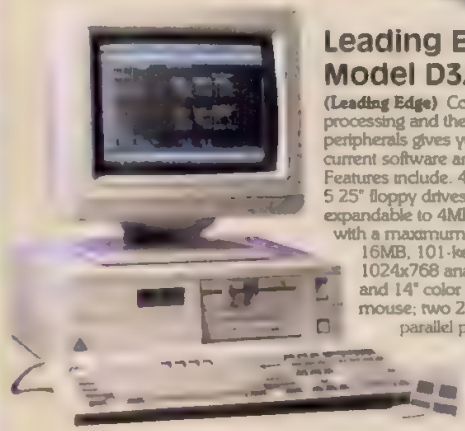

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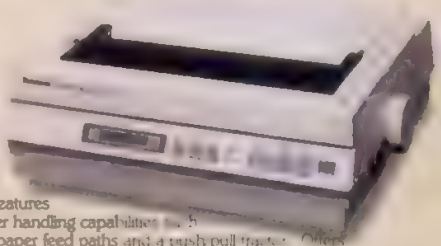
KX-P1124i



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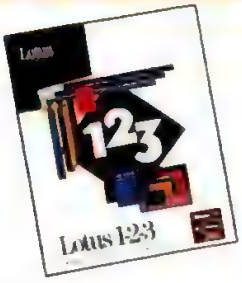

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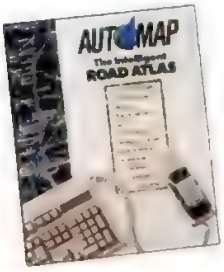

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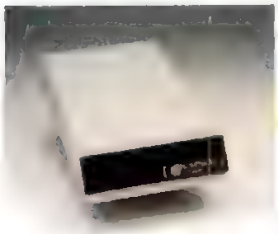

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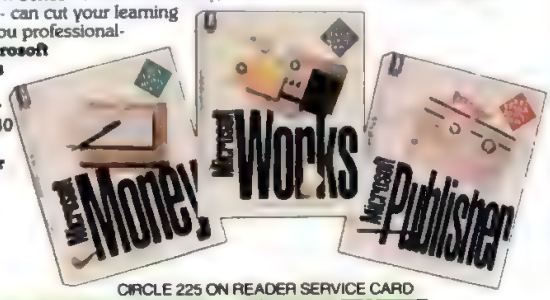

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KODAK *New Kodak Diconix 180si printer*

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pany's first portable thermal printer. At 8 pounds and $1,295 retail, this is not exactly a featherweight portable. Its performance is not lightweight, either. This 6-page-per-minute printer with HP PCL 4 is a powerful portable that can outgun many of its bigger, heavier, and more expensive brethren.

Mannesmann Tally has also brought out a 10-ppm desktop laser printer, which is based on the Konica engine and carries a list price of $3,195. It includes PCL 4 and the Microsoft Interpreter PostScript emulator.

REELS OF INK

The portable MT735's speed is the result of an ink reel, which looks like a roll of carbon paper. The sheet-wide reel spins while it melts ink on the paper, and it can perform this procedure as fast as it can move the paper past the mechanism. On PC Magazine Labs' speed tests, the MT735 churned out text at a healthy clip of 6.3 ppm in PCL mode. Graphics speed was also good, at 1.4 graphics pages per minute.

Because the printer uses each print reel only once, print quality is excellent. The drawback is that you get just 150 pages before you must replace the reel. But since a five-pack of extra ink rolls retails for $75, excessive printing won't get too expensive. The only drawback is that the extra print rolls cut down on the machine's portability; although light, they will take up space in your suitcase, and you have to remember them.

The MT735 measures 2 by 11 by 9 inches and weighs 8 pounds with its 115-volt battery adapter attached. It has a manual top feed and a built-in paper cassette, 1MB of RAM, a parallel port, and four resident emulations including Epson LQ, HP DeskJet, IBM Proprinter, and PCL 4. It accepts downloaded fonts in HP LaserJet II format (up to 178K) and prints in portrait and landscape modes. The four resident fonts include Courier, Math8, Swiss Proportional, and Timor. Courier and Math8 are multiple-pitch, and the others are 12-point typefaces. Unfortunately, there is no PostScript upgrade available.

NICE AND QUIET

Because it is a thermal wax transfer printer, the MT735 is also very quiet (rated at 45 dB). If you can find the space, you can print on an airplane without disturbing the other passengers. Battery life is claimed to last 150 letter-size pages, but we found that it could print more than that.

Paper loading is easy, and the MT735's paper cassette can accommodate up to about 80 sheets of paper. The top panel has five buttons for power, on-line, print quality, form-feed, and copy (which will output the last printed page). Five LEDs indicate Battery Check, Charger Active, Ribbon/Paper, Power, and On-Line. With many portable printers, changing the setup is not so easy. But with the MT735, if you don't mind rolling up your sleeves to figure out a few DIP switch settings, you won't get perturbed when you try to change fonts. If you ever get confused, you can always print a status page, which gives the correct settings for all fonts and emulations.

PORTABILITY

When compared with previous portable printers, the MT735 holds its own with any of them; it also has some of their drawbacks. The MT735 is not as bulky as the Canon BJ-10e (reviewed November 13, 1990); it is faster and lighter and has a comparable print quality. It also costs

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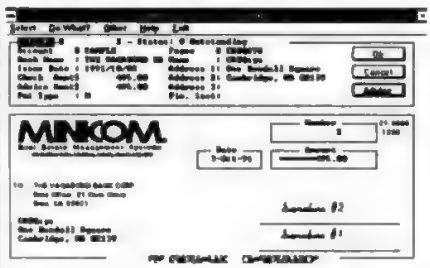

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three times as much. Unlike the Kodak Diconix 150 Plus (reviewed November 14, 1989), the MT735 can print on virtually any standard-size paper. It does not require a hard-to-find clay-based paper, but as our graphics sample shows, standard-stock paper is not the best print surface. For the darkest-quality print, you should find one of the grades of stock recommended by Mannesmann Tally.

10-PPM DESKTOP PRINTER

The Mannesmann Tally MT911 PS retails for $3,195. This pretty piece of change buys a 10-ppm Konica engine–based PostScript- and PCL 4–compatible laser printer with 85 fonts and a claimed 10-ppm output. For $600 less, of course, you could opt for the Mannesmann Tally MT911—which includes 35 fewer fonts and no PostScript. It's your pick. Either way, Mannesmann Tally has put much

NEW LAMPS FOR OLD: Are Recycled Cartridges Finally Worth Considering?

You'll certainly save money. One printer company even says toner cartridges are better the second time around. But HP and IBM want used cartridges ground up, not remanufactured.

by Susan G. Thomas

In the early 1980s, cost-conscious users of dot matrix and daisy wheel printers bought $30 ribbon re-inkers to get three or four lives out of their $5 ribbons. Often they saved enough money to pay for the shirts they ruined when they brushed up against the re-inkers.

The modern-day equivalent is the toner refill you can buy for your laser printer, but unlike ribbon re-inkers, refills may actually make sense. For $40 to $50 (half the price of a new cartridge), you get a clean refurbished or brand-new drum surface, along with a new load of toner. Do this three times—about the limit for reliability—and you can push per-copy costs down to a penny and a half per page. In comparison, using a cartridge just once will cost you up to 4 cents a page, plus a penny a page for the paper.

Toner cartridges are a big business. BIS Strategic Decisions, a Norwell, Massachusetts, market-research firm, says 15 million all-in-one laser toner cartridges will be used this year—enough cartridges to line the 1,893 miles from San Francisco to Chicago. (At retail prices, that comes out to $1.4 billion dollars in cartridges.) This high number is enough to panic environmentalists if these discarded cartridges wind up in landfills, and the hefty dollar amount should encourage business users to look for ways to save a few bucks.

At present, most used cartridges are discarded, rather than recycled or remanufactured. According to BIS analyst John Shane, "No more than 2 percent of cartridges are returned, even though companies will typically pay $7 to $10 for an OEMed empty SX cartridge."

DRILL AND FILL

The recycling or remanufacturing of laser-printer toner cartridges dates back to 1985, a year after Hewlett-Packard Co. introduced the first LaserJet. After holes were drilled into the cartridge, residual toner was drained and replaced with a fresh batch, and the cartridge was resold. This drill-and-fill technique practiced by garage shops did not take into account the wear on the scraper blades and photoconductor drums. Refilled cartridges produced lower-quality output than new cartridges, had shorter lifespans, and (in the eyes of laser-printer companies) may have exposed printers to damage.

By 1987, recyclers became more sophisticated. They disassembled the cartridges, then cleaned and inspected every part before adding toner.

By 1990, replacement parts, particularly photoconductor drums, became available, and refillers became remanufacturers. They replaced worn parts instead of refurbishing them, and the finished product was in many ways a virtually new toner cartridge.

HP: ONCE IS ENOUGH

Many laser-printer vendors won't have anything to do with remanufacturing. But they will take back old cartridges and as a gesture to the environment make a contribution to a environmental group. Cynics will smugly point out that another reason for doing this is to take the cartridges out of circulation before they fall into the hands of the refillers.

Canon USA and HP won't remanufacture cartridges; they recycle the plastics and metals from spent ones and then sell the raw products. "We do this to maintain the quality of cartridges that our customers expect. Our recycling program is strictly not-for-profit," says Cindy Dwyer, marketing communications coordinator for HP's LaserJet Supplies and Accessories Division. HP pays for the shipping costs of returned cartridges and donates $1 per cartridge to the National Wildlife Federation or the Nature Conservancy. For more information, contact HP at 800-752-0900.

Other companies are following in HP's footsteps. IBM Corp./Lexmark and Xerox Corp. plan similar programs that should be in place by year's end.

QUME: IT'S BETTER THAN NEW

Not all printer makers agree with HP and IBM. Dataproducts Corp. (800-423-5095) and Qume Corp. (800-421-4326) remanufacture their cartridges for resale. They pay up to $10 for every returned cartridge. The latter company coats the photoconductor drum by using a direct image polymer process, which protects the drum from toner wear and tear; this process, Qume explains, means that the cartridges remanufactured in its Environmentally Correct Program have not only a longer life but improved quality as well.

Dataproducts isn't convinced that drums can withstand multiple lives, so it replaces the photoconductor drums with new drums, then remanufactures the other wearable parts, yielding a cartridge it says is equal in quality to a new one. ■

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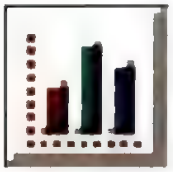


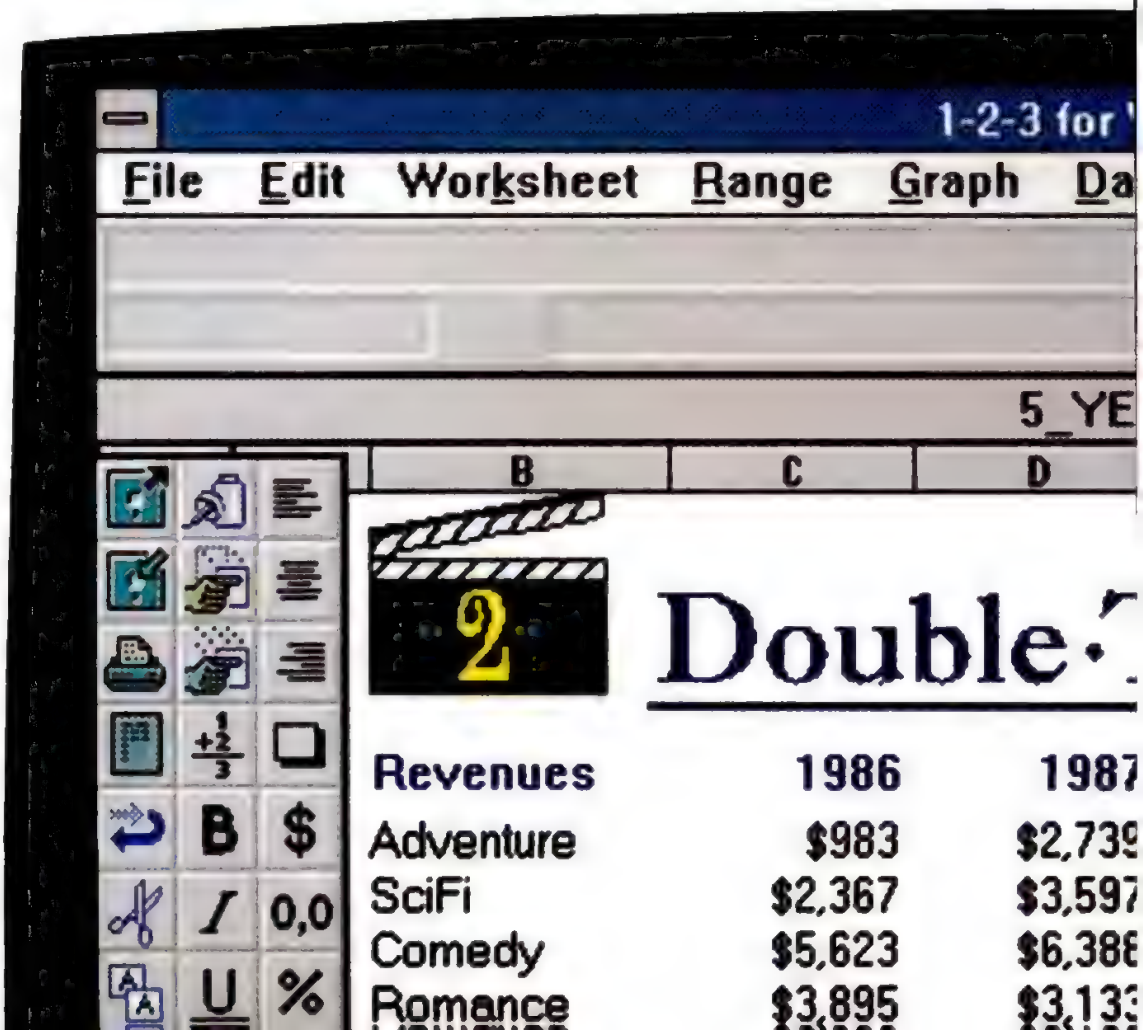
These fully customizable SmartIcons give you push button access to basic and advanced spreadsheet functionality. Just by pointing and clicking the mouse. For example, sum a column or a row or change text to bold, all in a single step.

But it's not just 1-2-3 running on Windows. It's 1-2-3 taking full advantage of it. For example, with its innovative use of SmartIcons,™ you can automate common spreadsheet tasks, just by pointing and clicking the mouse. Or create new icons based on your unique needs.

If you're a Windows user, you'll be comfortable with its pull-down menus,

"In 1-2-3 for Windows, Lotus offers a true, no-compromise Windows application as well as outstanding backward compatibility with earlier versions."
*—PC COMPUTING, 9/91**

"The new 1-2-3 has some interesting Windows features, especially the 'icon palette' that allows users to build a customized set of point-and-click commands. That feature is so handy that Microsoft and Borland have quickly vowed to match it in future versions of their own spreadsheets."
—THE NEW YORK TIMES, 9/8/91



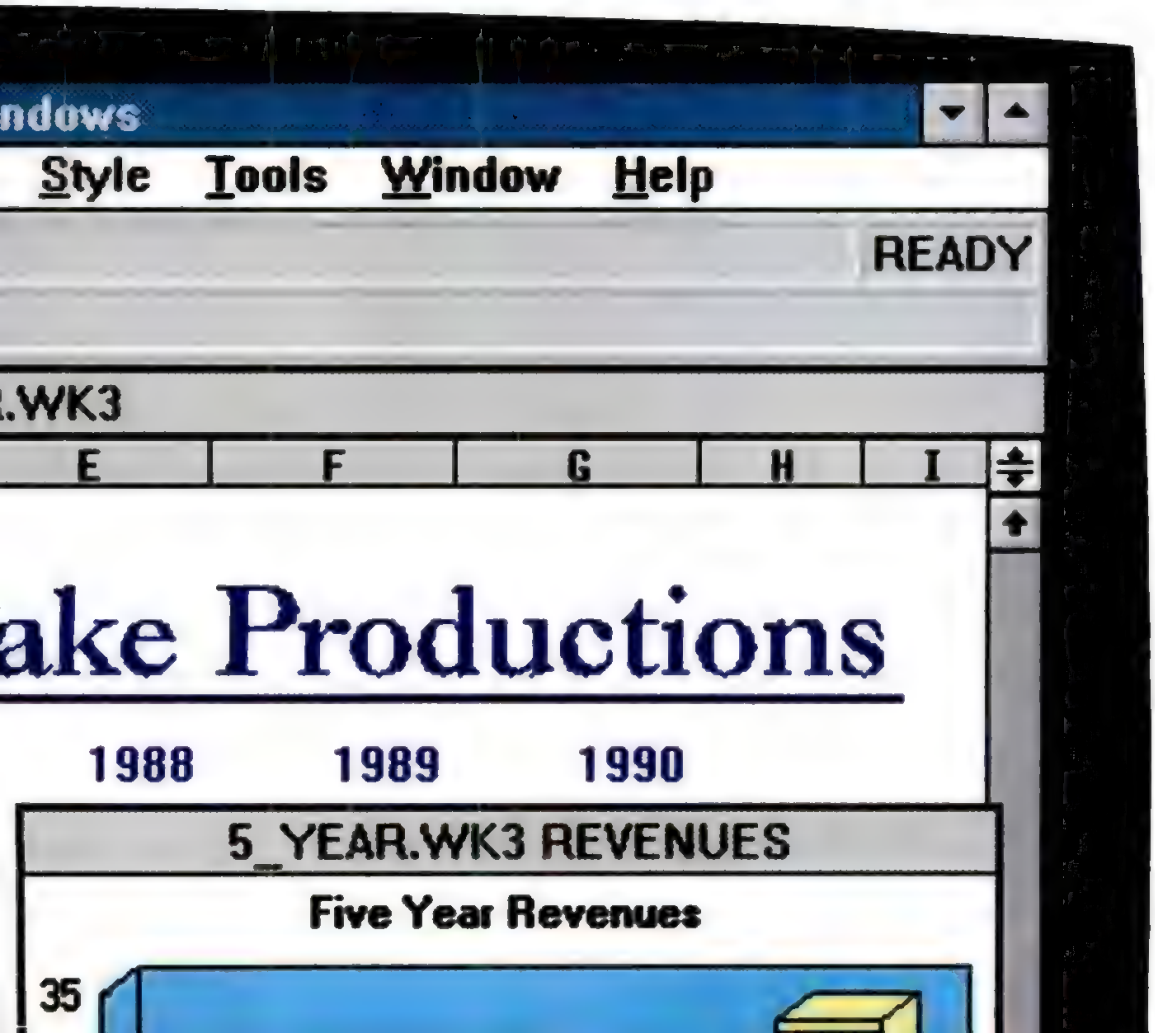
ndows.

dialog boxes, sizable windows and mouse support. What's more, 1-2-3 for Windows delivers superior spreadsheet publishing capabilities. Along with industry-leading spreadsheet technologies such as 3D worksheets, Solver goal-seeking features and external data access through Datalens.® Better still, if you're a current 1-2-3 user, you'll have instant access to the 1-2-3 Classic® menu merely by pressing the slash (/) key. Which means any 1-2-3 user will feel right at home from the start.

So see why Lotus® 1-2-3 for Windows is more than a great Windows spreadsheet. It's everything you've been looking for in one.

For a free auto demo or to order your upgrade, call **1-800-872-3387, ext. 6296.**

Lotus 1-2-3 for Windows



For DOS.

Two terrific spreadsheets for DOS, both distinctly 1-2-3.

Sure, the software world is excited about Windows. But there's also a world of people committed to DOS. And we haven't forgotten them. That's why we've continued to enhance the functionality of our two DOS spreadsheets. Both of which run in a graphical WYSIWYG environment, featuring full mouse support, File Viewer, Auditor and outstanding publishing capabilities.

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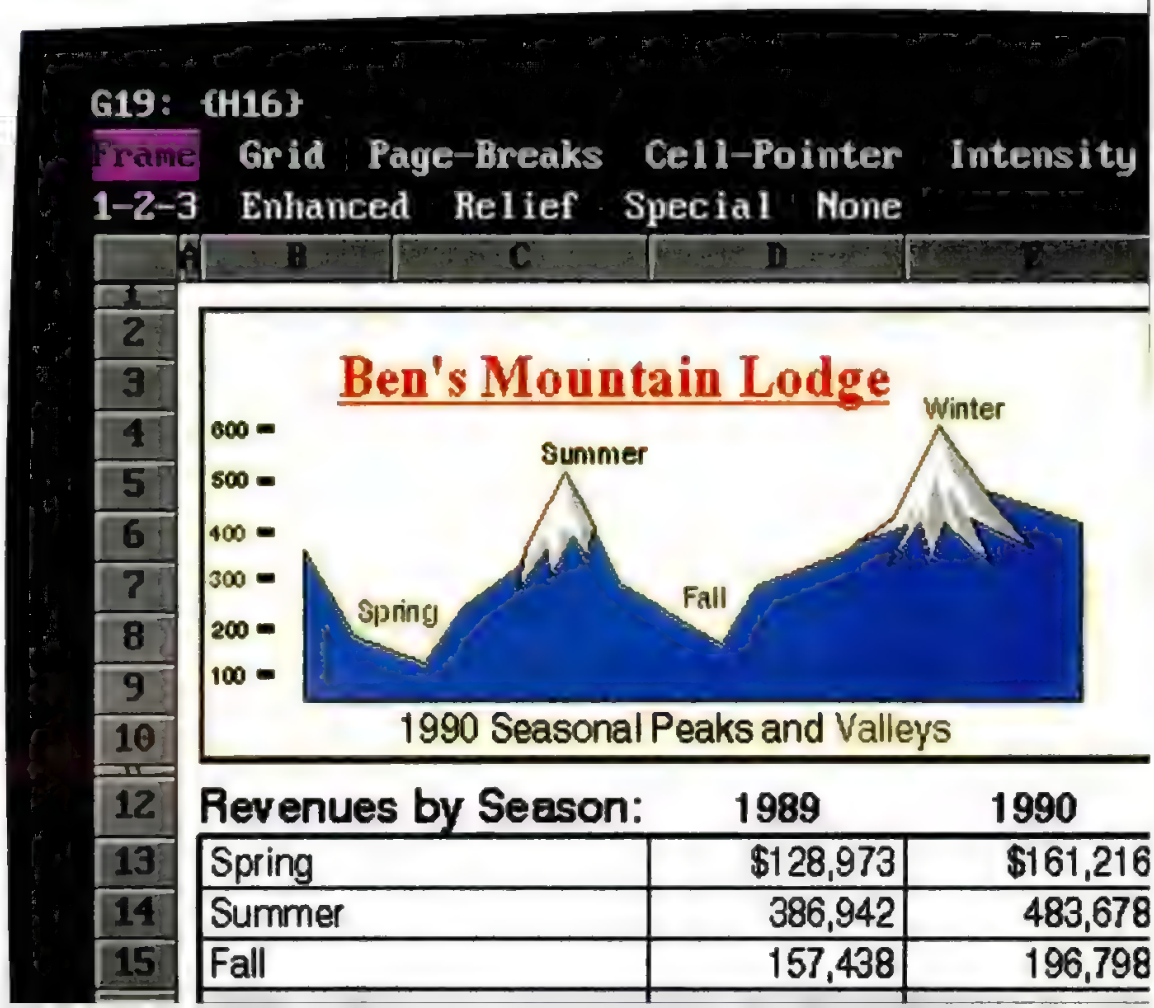
Lotus 1-2-3 for DOS

"With 1-2-3 Release 2.3 Lotus has not only made it possible to work with your spreadsheet while it displays fonts and graphics, but it has made the product very fast at doing so."
—INFOWORLD, 5/13/91

"...latest release of 1-2-3 for DOS, 3.1+, couples utilities from its 1-2-3 siblings with the package's inherently powerful three-dimensional capabilities."
—PC WEEK, 8/5/91



For Mac.

The power of 1-2-3. The essence of Macintosh.®

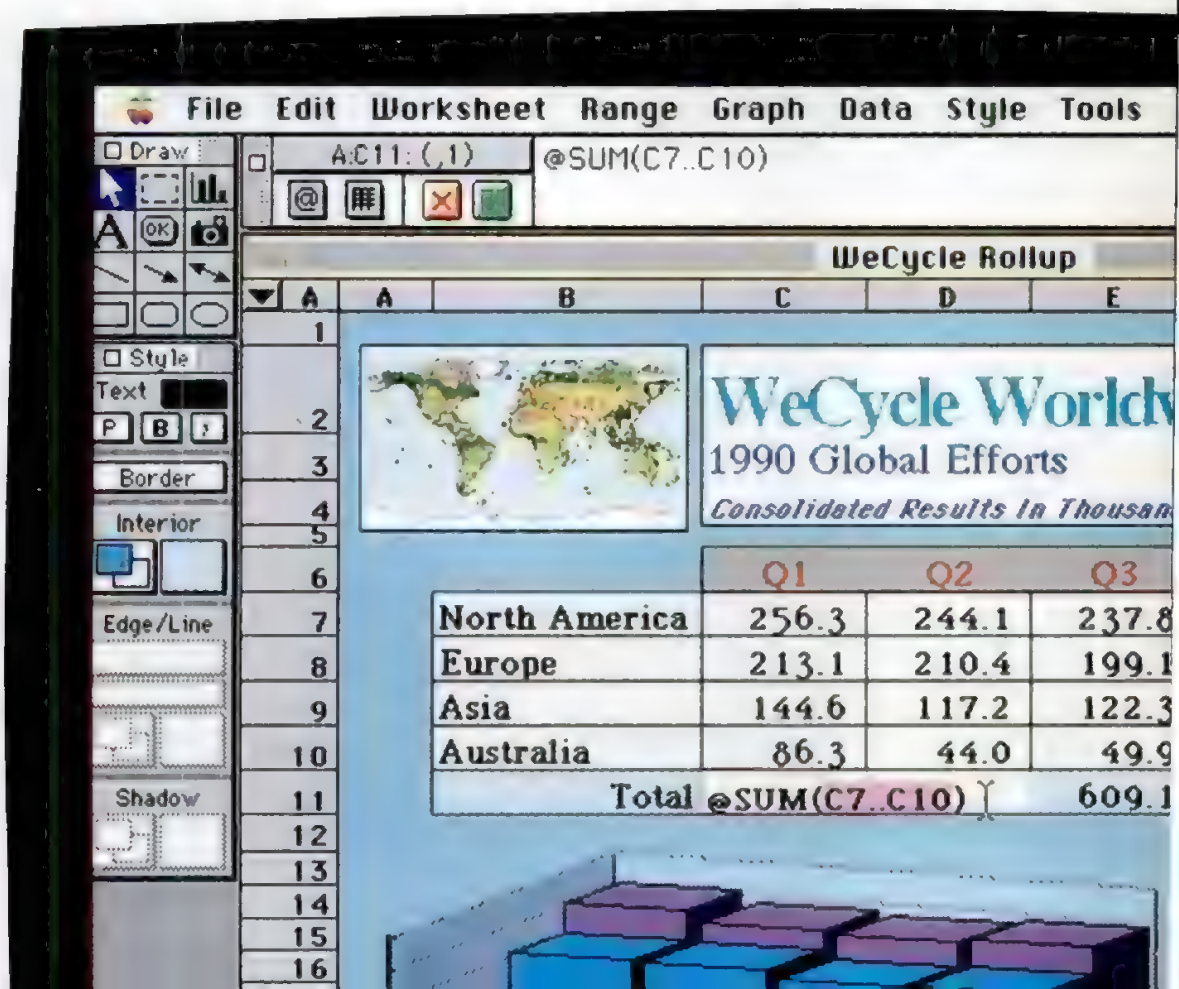
From the time you first click on the 1-2-3 icon, it's clear that this version of 1-2-3 is a full-fledged, no-holds barred Mac® application.

Although we designed it from the ground up for Macintosh, we've still made it completely compatible with all other versions of 1-2-3. Which means you get complete file, format and macro compatibility. And it includes features that are uniquely 1-2-3, such as true 3D technology. Of course, 1-2-3 for Macintosh works with either System 6 or System 7, and everything that comes with it.

So see what happens when the power of 1-2-3 works together with the essence of Macintosh. Lotus 1-2-3 for Macintosh will be available soon. In the meantime, call **1-800-872-3387, ext. 6293.** for a free demo video.

Lotus 1-2-3 for Macintosh

a spectacular product.
JOHN SCULLY
CHAIRMAN AND CEO
APPLE COMPUTER, INC.



For OS/2.

The 1-2-3 spreadsheet that fully exploits the graphical environment of OS/2.

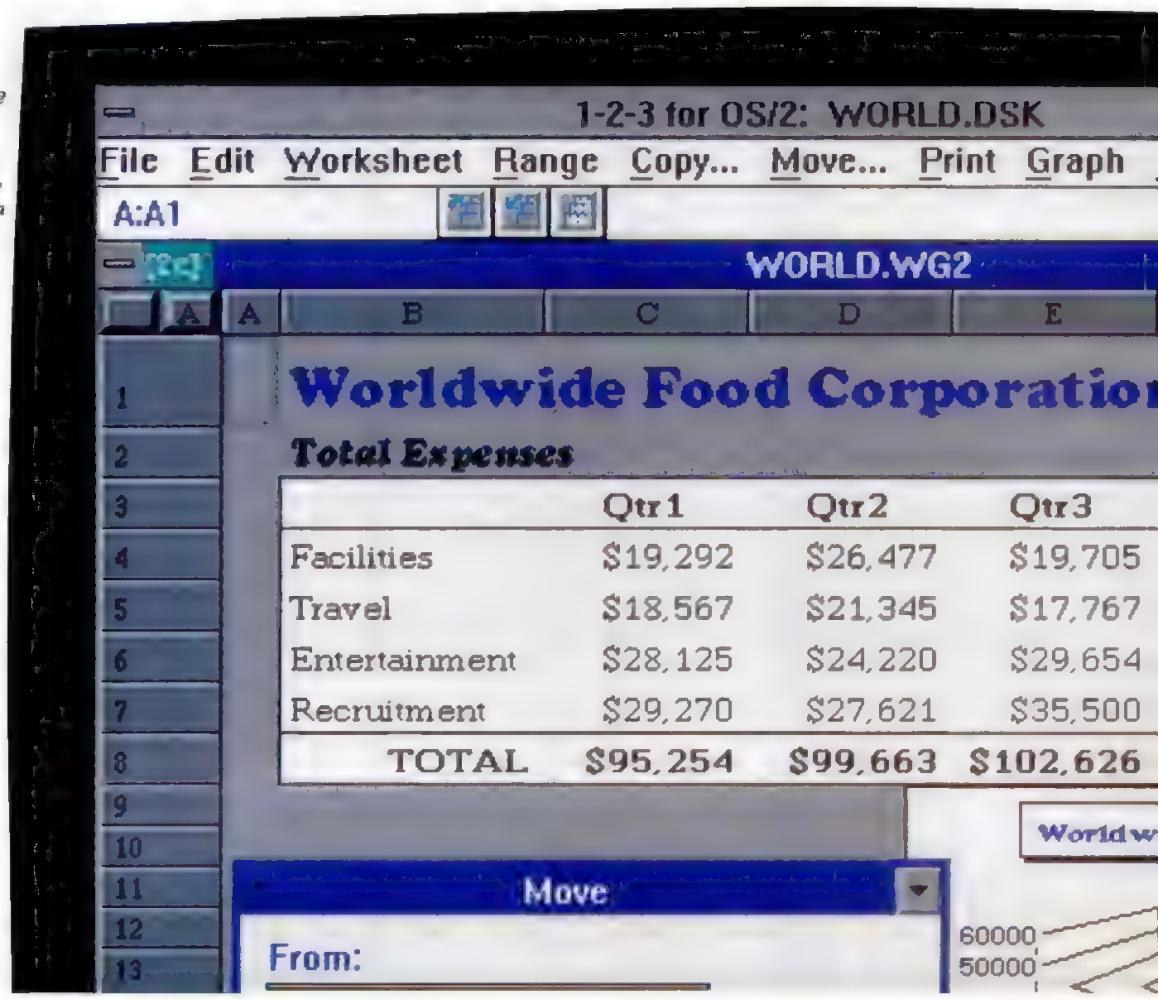
This is the spreadsheet that takes advantage of the speed, memory and multi-tasking capabilities of OS/2.® It delivers all the power you'd expect from 1-2-3, including true 3D worksheets, file-linking and access to external databases. Without compromising any of the compatibility concerns you may have.

Nor does it sacrifice any of your knowledge of 1-2-3. In fact, you can use either the mouse or the keyboard, whichever you prefer. Lotus 1-2-3 for OS/2 was also the first spreadsheet to introduce the unique Solver technology to help you turn "what-if" problems in your worksheets to "how-to" solutions.

So if you're thinking of moving to the world of OS/2, you needn't worry. We're already there. For more information, call **1-800-872-3387, ext. 6294.**

Lotus 1-2-3 for OS/2

Thanks to its multi-windowing capabilities, 1-2-3 for OS/2 lets you look at your graphs and spreadsheet simultaneously. Whether it's working with a 3D file or bringing in information from external databases the full power of 1-2-3 for OS/2 is always within reach.



For UNIX.

The spreadsheet standard, 1-2-3, optimized for UNIX.

All the features and functionality of Lotus 1-2-3, the world's most popular spreadsheet, are there for you in the world of UNIX.® In fact, 1-2-3 is running on UNIX-based workstations from leading hardware vendors. As well as on PCs running either UNIX or XENIX® operating systems.

1-2-3 for UNIX offers powerful analytical and presentation capabilities. And it's completely compatible with all versions of 1-2-3. Which means if you're moving to the UNIX environment, your files, macros and knowledge go with you. And of course, our UNIX customer-support team will be there to help you along the way.

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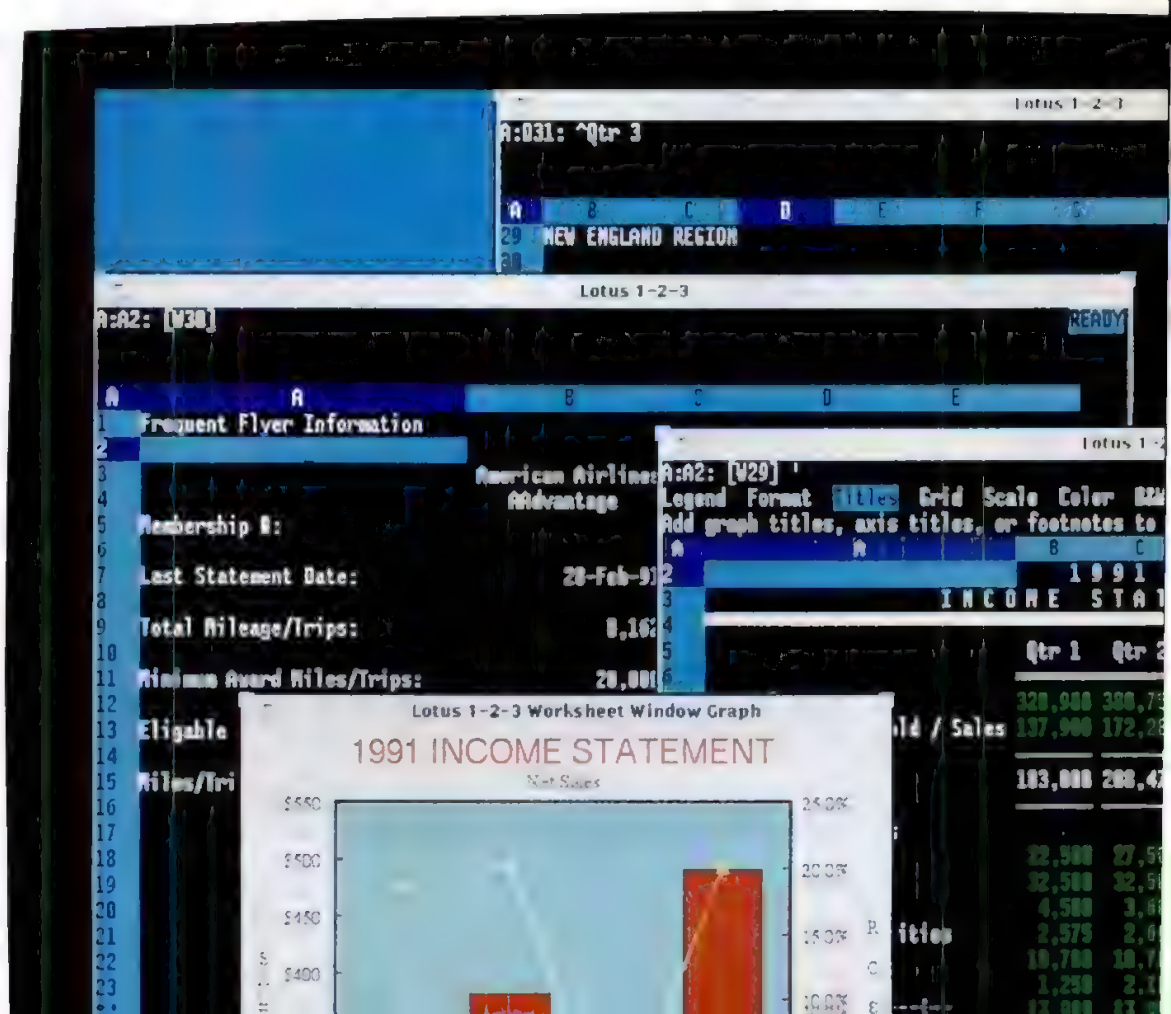
For more information on a specific platform or for the name of the Lotus Authorized Reseller nearest you, please call **1-800-343-5414, ext. 6295.**

Lotus 1-2-3 for UNIX

1-2-3 for UNIX lets you take advantage of the 3D technology and advanced file-linking found in other versions of 1-2-3.



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Lotus 1-2-3. The only spreadsheet that works together across all major operating platforms.

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Plus, we're committed to enhancing our spreadsheets to exploit their operating environment with innovations that make them more powerful and easy to use.

What's more, each of our 1-2-3 spreadsheets is supported not only by a host of add-in applications, but also by comprehensive Lotus customer service, including 24-hour 7-day a week toll-free service.**

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care into this machine and has kept the user's needs in mind.

Although the Konica engine does not have a single-piece photoconductor system, the MT911 PS's setup is still quite straightforward. The documentation is clear and concise and basically tells you three things: (1) remove the packing tape, (2) insert the toner bottle, and (3) turn it on. With the drum and all working parts already in place, you are ready to print; it's that easy.

If you want to change any of the default settings, the front panel has three buttons and a 16-character LCD, with which you can easily view and select emulations, the menu language, alarms, lines per inch, fonts, symbol sets, copies, and more. You can save up to four user-defined setups, and you can also select I/O settings, including data bits, parity, stop bits, data rate, and protocol.

SPEEDY PCL

For $2,595, you can buy the MT911 without the PostScript option and with PCL 4 as the only emulation to come standard. Epson FX and IBM Proprinter emulations are available at $250 for the MT911 and the MT911 PS. On our speed tests, in the default PCL 4 emulation, the MT911 PS printed text and graphics with speed and clarity, turning out text pages at 9 ppm and graphics at 2.4 gppm, and making it the fastest PostScript/PCL printer in PCL text mode and the second-fastest in PCL graphics mode. (See the performance test results.)

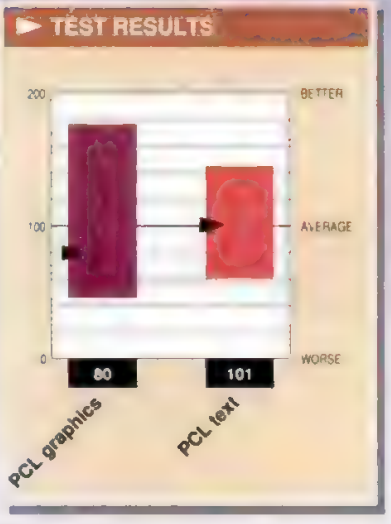
Using the Microsoft Interpreter, the MT911 PS also did very well on our PostScript text speed test. At 8.9 gppm, it came in second among all printers with PostScript as a standard option. On our PostScript graphics speed test, however, the MT911 PS tied for last place, with a speed of 0.3 gppm. But you may decide the output is worth the wait: Graphics were as smooth as the handle on an old man's cane, and shades of gray blended as naturally as a thickening fog. It is very impressive output indeed.

The MT911 PS measures 14 by 18 by 24 inches and weighs 42 pounds. It comes with 2.5MB of RAM (expandable to a total of 4.5MB), a 200-sheet paper cassette, a parallel and an RS-232C serial port, and 85 resident fonts. An optional legal-size paper cassette retails for $75, and a 500-sheet paper cassette is obtainable for $395. Also available are two additional interfaces: An optional $250 AppleTalk port and a $525 four-port RS-232C kit, with 512K of RAM expandable to 2MB.

Optional $185 Smart Cards give users access to an array of PCL 4–compatible fonts. You can also use the Smart Cards as ROM, allowing you to store macros, logos, and signatures.

Although a bit on the pricey side, the Mannesmann Tally MT911 PS provides solid speed, ease of use, and excellent print quality. The vast array of options make the MT911 PS an intelligent choice for an office with multiple or expanding needs. And the Mannesmann Tally MT735 is a good portable printer as well, despite the lack of a PostScript upgrade. If you ever have to print graphics while on the road, justifying the $1,295 price tag may not be necessary. No other portable printer offers the speed of the MT735. For that matter, neither does any of the desktop laser printers.

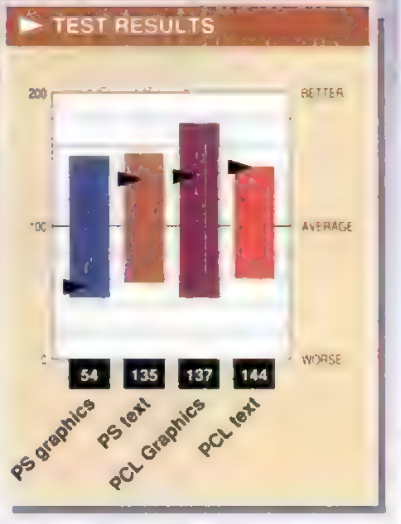
Mannesmann Tally MT735



PCL scores

In Short: The only portable printer with laser-quality output, the $3,195 Mannesmann Tally MT735 is fast and quiet, a must-have for printing graphics on the road. It is based on a 6-ppm thermal engine and comes with HP PCL 4, but it lacks a PostScript upgrade.

Mannesmann Tally MT911 PS



PCL and PostScript scores

In Short: The Mannesmann Tally MT911 PS, based on the 10-ppm Konica LP3110 engine and the Microsoft Interpreter PostScript emulator, provides solid speed, good PostScript-compatible output, and ease of use. At $3,195, however, it is a bit expensive.

FACT FILE

Mannesmann Tally Corp., 8301 S. 180th St., Kent, WA 98032; 800-843-1347, 206-251-5524.

Mannesmann Tally MT735
List Price: $1,295.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 2 x 11 x 9 inches.
Weight: 8.3 lbs.
Emulations: Epson LQ, HP DeskJet, HP PCL 4, IBM Proprinter.

Mannesmann Tally MT911 PS
List Price: $3,195; Epson FX and IBM Proprinter emulations, $250 each; Smart Cards, $185 each; large-capacity letter-size paper cassette, $395; legal-size paper cassette, $75; A4-size paper cassette, $75; four-user serial I/O interface, $525; AppleTalk I/O interface, $250.
Standard Warranty: One year on parts and labor, with on-site service the first 90 days.
Dimensions (HWD): 14 x 18 x 24 inches.
Weight: 42 lbs.
Emulations: HP PCL 4, Microsoft Interpreter PostScript emulator, MT Superset Commands.

CIRCLE 545 ON READER SERVICE CARD

Now you can change text, graphics, fonts and fast as you change you

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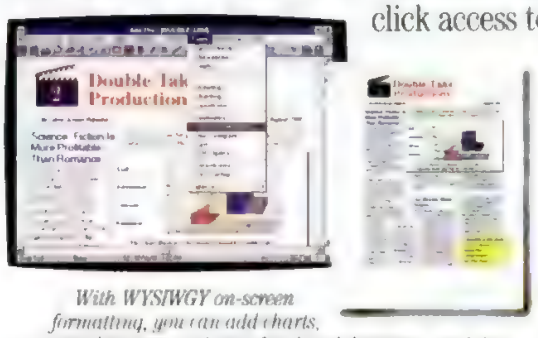

With WYSIWGY on-screen formatting, you can add charts, scanned images and even free-hand drawings, and then wrap text around any graphic you want

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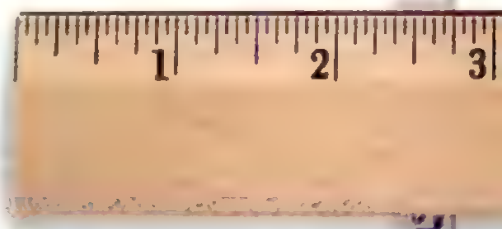

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CIRCLE 189 ON READER SERVICE CARD

MOBY BRICK™

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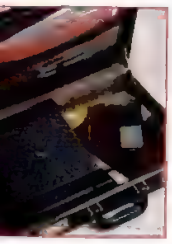
If your PC has become too indispensable to leave behind, yet your performance demands are beyond the capabilities of today's notebooks, then Moby Brick is your answer. It offers the fastest 486-33 performance available, enormous storage capacity, and exceptional graphics in a delightfully quiet, stylish design. There is simply not a faster or nicer desktop PC available.



This claim is supported by worldwide editorial praise and prestigious awards and includes IDSA's Best Product Design of the Year,

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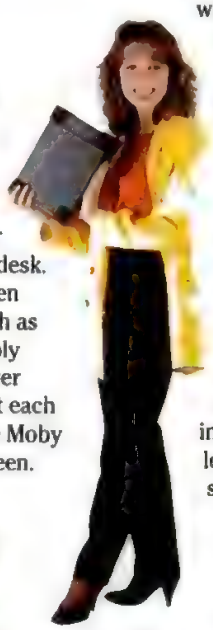
Unlike traditional desktops, which limit you to a single location, you can use Moby Brick with its blazing performance and all your data away from your desk. For computing between regular locations, such as home and office, simply keep a keyboard, power supply and monitor at each site and carry just the Moby Brick module in-between.



1990 FINALIST

The Awesome Roadwarrior

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Moby Bricks are available with either 20MHz 486SX or 33MHz 486DX processors and 4, 8, 16 or 32MB RAM. (386SX based Bricks are also available.) All Bricks feature reliable IDE Conner hard disks including 44MB (28ms), 120MB (19ms), 212MB (15ms), or 510MB (13ms) combined with a unique BIOS integrated disk cache (8MB max.) to provide the highest performance. The built-in 16-bit Super VGA graphics offers up to 1024 x 768 non-interlaced resolution with 1MB video RAM. Other standard features include a 2,400bps modem, 3.5" 1.44MB floppy, and an ISA 16-bit internal half length exp. slot.

Bricks are 100% IBM® AT-compatible and support DOS, OS/2, UNIX, QNX, X/Windows and Novell.

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Bricks are available directly from Ergo—the same people who design, manufacture and support them. However, a good deal is only one of the reasons you'll enjoy doing business with Ergo. We offer unlimited, toll-free technical phone support, overnight repair service, a one-year warranty and a no nonsense, 30-day satisfaction guarantee.

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$4,995

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- One 16-bit half length int. exp. slot
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intel inside

Options

212MB 16ms hard disk	add $600
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Additional RAM per MB	$100
Docking Terminal w/16-bit slot	$395
VGA LCD module	$995
250MB tape backup	$645
101 keyboard (beige or grey)	$109
Padded Cordura Brick Bag	$99
14" 1024 x 768 VGA monitor (beige)	$495
15" 1280 x 1024 VGA monitor (grey)	$895
17" 1280 x 1024 VGA monitor (shown)	$1,395

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MICROTEK LAB INC.

Microtek TrueLaser

by Joseph Desposito

The $2,695 Microtek TrueLaser starts with the common 6-page-per-minute TEC engine and HP PCL 4 and goes on to add an AMD 29000 RISC processor, the Microsoft TrueImage PostScript interpreter, and automatic switching among its three standard ports. What is most impressive about the TrueLaser is its graphics speed in PostScript mode, where it beat all

▪Microtek TrueLaser

the desktop laser printers with PostScript as a standard feature.

The TrueLaser is targeted at low-end office users who do light graphics work. Due to the RISC chip's speed, Microtek also expects the TrueLaser to be used as a page-proof printer. You can connect the TrueLaser to IBM-compatible and Apple Macintosh computers. Microtek uses national distributors, such as Ingram Micro and Merisel, who then sell to dealers. The TrueLaser has a one-year warranty on parts and labor, with on-site service from Avery Dennison for the first six months.

FAST POSTSCRIPT GRAPHICS

Using the 32-bit AMD 29000 RISC processor, the TrueLaser zipped through our graphics speed test at 1 graphics page per minute, beating all the desktop laser printers that provide PostScript as a standard feature. (The IBM LaserPrinter 10, with its optional Adobe PostScript cartridge, was even faster, at 1.2 gppm.) At 6.1 ppm, the text speed exceeded the rated engine speed in PostScript mode.

In PCL mode, the TrueLaser was a little faster than other 6-ppm TEC engine–based laser printers. It produced graphics at 1.8 gppm and text at 5.8 ppm.

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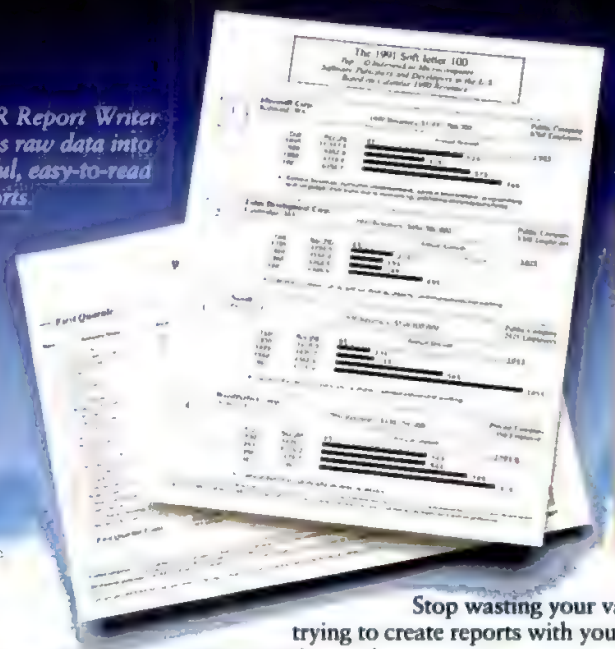

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CIRCLE 315 ON READER SERVICE CARD

PRESTIGE ELITE IQE UNIV COND IQE BOOK ONE IQE PALANGRAPHIC CG TIMES

PostScript Variety, LaserJet III Compatibility In The New Super Cartridge 3

Compare	IQE Super Cartridge 3	PostScript Cartridge	Scalable Cartridge
Familiar 35 PostScript typeface equivalents - PLUS 15 bonus typefaces	Super	No	No
Operates without any additional printer memory	Super	No	Yes
Ability to send documents to Linotronic printer	Super	Yes	No
Prints at the full speed of the LaserJet III	Super	No	Yes
Contains fully scalable Courier (fixed pitch) for spreadsheets	Super	Yes	No
Contains fully scalable Prestige Elite (fixed pitch) for spreadsheets	Super	No	No
Only non-HP scalable font cartridge with the new driverless AutoFont files	Super	No	No
Functions with all the LaserJet III's resident fonts	Super	No	Yes
Each typeface can access over 40 symbol sets	Super	No	No
Documented as best scalable cartridge for the LJ III by industry professionals	Super	No	No
Unique, decorative typefaces in a single cartridge	Super	No	No

The Best Scalable Font Cartridge For HP LaserJet III Printers.

IQ Engineering announces a super font cartridge for the HP LaserJet III family of printers. With all its features, it's easy to see why PC Magazine says the new IQE Super Cartridge 3 product "is probably the only font cartridge you'll ever need for the LaserJet III." *PC Magazine, 2/12/91.*

No longer is PostScript your best option. It's costly, cumbersome and slow.

Now you can choose from more than 35 standard PostScript-like typefaces for your documents without sacrificing any of the LaserJet III's features. Features like Resolution Enhancement, HP-GL2 Graphics, reversed type, shaded text, and quick, 8-pages-per-minute printing.

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Better still, the Super Cartridge 3 is easy to use and easy to install. We even have scalable fixed pitch fonts for spreadsheets and bonus decorative type styles for versatile Desktop publishing applications.

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The IQE Super Cartridge 3 fonts are the latest in our award-winning product line. So, whether you use the original HP LaserJet, any LaserJet II, a DeskJet, or the latest LaserJet III printer, we have a cartridge that fits your needs, your network and your budget.

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CIRCLE 325 ON READER SERVICE CARD

The TrueLaser delivers excellent print quality for both text and graphics and flawless PostScript compatibility. The TrueLaser has 35 internal TrueType fonts, which are named differently from their Adobe PostScript counterparts but look basically the same. For example, the Adobe PostScript Helvetica font is very similar to the TrueType Arial font.

The PCL 4 emulation contains three basic PCL fonts, but the TrueLaser accepts the 25 Cartridges in One! font cartridge from Pacific Data Products, too. (HP cartridges will not work in the printer.)

Although the TrueLaser does not support automatic emulation switching, it does perform automatic interface switching among the parallel, RS-232C serial, and AppleTalk ports, all of which come standard. When a print job starts coming through any port, the TrueLaser automatically services that port until the job is completely done.

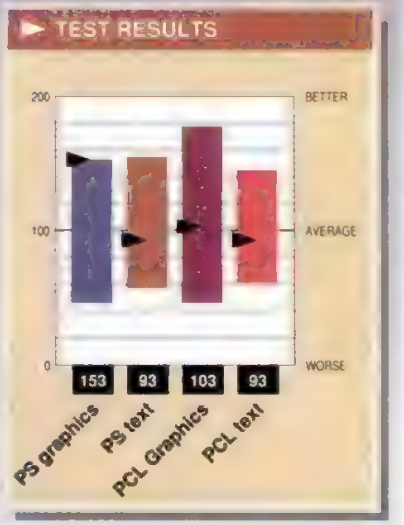
A control panel with membrane switches is spread across the front of the TrueLaser and includes a 16-character LCD at the left-hand side. In normal operation, there is little need to use the panel except if you want to change emulations. The panel is straightforward to use and is adequately explained in the manual.

The TrueLaser uses a 150-sheet paper cassette that fits into the printer's right side. On top of the paper cassette is a mechanism that feeds single sheets of paper and also envelopes. The TrueLaser can eject paper either through the top or straight through to the printer's left side. Two cartridge slots are located directly below the paper cassette, and the three ports are on the back of the printer.

Though the TrueLaser comes standard with 2MB of RAM, Microtek is running a promotion extending through December 1991: You can get an additional megabyte of RAM (list price $295) for free. A package containing two toner cartridges retails for $49, and each cartridge lasts for about 1,500 pages. The drum retails for $149 and lasts for about 10,000 pages.

For fast PostScript graphics, the Microtek TrueLaser can't be beat. With PCL 4 and automatic switching among the three built-in printer ports, the TrueLaser is a very good choice.

Microtek TrueLaser



PCL and PostScript scores

In Short: Among all the desktop lasers with PostScript compatibility, the $2,695 Microtek TrueLaser finished in first place on our PostScript graphics test, using the 6-ppm TEC 1305-Z engine and the Microsoft True Image PostScript interpreter. It also has HP PCL 4, automatic switching among three built-in ports, and a RISC processor.

FACT FILE

Microtek Lab Inc., 680 Knox St., Torrance, CA 90502; 213-321-2121.
Microtek TrueLaser
List Price: $2,695; 1MB RAM upgrade, $295; 4MB RAM upgrade, $895.
Standard Warranty: One year on parts and labor, with on-site service the first six months.
Dimensions (HWD): 9 x 25 x 16 inches.
Weight: 35 lbs.
Emulations: HP PCL 4, Microsoft TrueImage PostScript interpreter.

CIRCLE 546 ON READER SERVICE CARD

NEC TECHNOLOGIES INC.

NEC Silentwriter2 990

by Edward Mendelson

The NEC Silentwriter2 990 is a slightly updated version of the NEC Silentwriter2 290, which we reviewed last year. It provides HP PCL 4 and true Adobe PostScript, in addition to software-based automatic emulation switching. Using a RISC processor, the Weitek XL8200, the Silentwriter2 990 performs solidly, though not spectacularly, on text and graphics in both modes. But given a list price of $4,495 and a street price around $3,400, you can definitely find much better buys elsewhere.

The Silentwriter2 990 is rated at 8 pages per minute and uses the Canon LBP-UX engine. This engine is functionally similar to the familiar SX engine used by the HP LaserJet III (and uses standard EP-S toner cartridges), but it is built to fit in a more compact case. The printer's case, which looks a bit like a postmodern office building, is taller than most 8-ppm laser printers but occupies less desktop

NEC Silentwriter2 990

NEC Silentwriter2 990

PCL and PostScript scores

In Short: The NEC Silentwriter2 990 has all the right features: an 8-ppm Canon LBBP-UX engine, genuine Adobe PostScript, HP PCL 4, and automatic emulation switching. But its list price of $4,495 makes us suggest you look elsewhere.

space. It uses a 200-sheet paper cassette that is very similar to the one used by the HP LaserJet III. One uncommon feature is backlighting for the 16-character LED on the control panel. This is one of the few printer displays that you can actually read without squinting.

SAME SPEEDS AS LAST YEAR

On PC Magazine Labs' speed tests, the Silentwriter2 990 performs identically to last year's Silentwriter2 290. In PCL mode, its text speed was 7.5 ppm, and in PostScript it was 7.4 ppm. In graphics mode, the PCL score was 1.6 gppm, and the PostScript speed was 0.7 gppm. These are perfectly respectable scores for machines in their class, but other desktop laser printers such as the $1,999 Okidata OL830 (reviewed in this section) surpassed them for less money.

In its PostScript mode, the Silentwriter2 990 offers the standard 35 fonts and Version 52.3 of the PostScript interpreter—one of the latest versions of PostScript Level 1. As a LaserJet, the printer successfully emulates HP PCL 4 and adds what NEC calls "HP PCL 4.5." This boost provides support for scalable Courier, Helvetica, and Times typefaces that are in fact the corresponding PostScript typefaces used in PCL mode. The character widths won't exactly match the widths of those produced by HP Times and Helvetica cartridges and soft fonts, and you can't use LaserJet-compatible font cartridges. Last year's Silentwriter2 290 didn't support the full PC-8 character set; the new model does.

In the shipping box you will find a copy of LaserTools Corp.'s *PrinterControl Panel* software for automatic switching between PostScript and PCL modes,

DESKTOP LASER PRINTERS: SUMMARY OF FEATURES

Products listed in alphabetical order

	Bézier BP4040	Brother HL-4PS	Brother HL-8V	C. Itoh ProWriter CI-4	Dataproducts LZR 960	DEClaser 1150	DEClaser 2150	DEClaser 2250
List price (tested configuration)	$1,895	$2,595	$2,495	$1,245	$2,995	$3,049	$3,499	$5,149
PHYSICAL CHARACTERISTICS								
Dimensions (HWD, in inches)	8 x 28 x 14	8 x 16 x 14	9 x 18 x 25	8 x 14 x 23	11 x 13 x 14	8 x 14 x 16	9 x 18 x 21	12 x 18 x 27
Weight (pounds)	26	27	44	29	34	25	45	67
ENGINE								
Engine type	Laser	Laser	Laser	Laser	Laser	Laser	Laser	Laser
Model	Canon LX	Canon LX	Canon SX	TEC 1321C	Sharp JX-95	Canon LX	Canon SX	Canon RX
Rated speed (pages per minute)	4	4	8	4	9	4	8	8
Single-cartridge toner/ developer/drum	■	■	■	❑	❑	■	■	■
Toner capacity (copies)	3,500	3,500	4,000	2,500	3,000	3,500	4,000	4,000
Memory	2MB	2MB	1MB	512K	2MB	2.5MB	2.5MB	4MB
Maximum resolution (horizontal by vertical dots per inch)	300 x 300	300 x 300	300 x 300	300 x 300	300 x 300	300 x 300	300 x 300	300 x 300
Controller with RISC processor	AMD 29000	None	None	None	Weitek 8200	None	None	None
INTERFACES								
Parallel	■	■	■	■	■	■	❑	■
Serial	■	■	■	■	■	■	■	■
AppleTalk	■	■	❑	❑	■	❑	❑	❑
Automatic interface switching	■	❑	■	❑	■	❑	N/A	❑
Simultaneously active ports	■	❑	❑	❑	■	❑	N/A	■
PAPER HANDLING								
Number of paper cassettes	1	1	1	1	1	1	1	2
Cassette capacity (sheets)	70	50	200	100	250	50	200	200 each
Duplexing	❑	❑	❑	❑	❑	❑	❑	■
Rated maximum paper weight (pounds)	28	28	36	32	31	28	35	35
FONTS AND FEATURES								
HP PCL support	PCL 4	PCL 4	PCL 5	PCL 4	PCL 4	PCL 4	None	None
Supports scalable fonts	❑	■	■	❑	❑	❑	N/A	❑
Accepts HP-compatible font cartridges	❑	❑	■	■	❑	■	N/A	❑
PostScript language support	Microsoft TrueImage	Brother BR-Script	None	None	Adobe Level 2	Adobe Level 1	Adobe Level 1	Adobe Level 1
Supports Type 1 fonts	■	■	❑	❑	■	■	■	■
Supports automatic emulation switching	❑	❑	❑	❑	❑	■	❑	❑
Accepts proprietary font cards	❑	■	■	❑	■	■	■	■

—Editors' Choice ■—Yes ❑—No * This product uses a video I/O interface.

N/A—Not applicable: The product does not have this feature.

and other disk-based software that lets you switch modes from the DOS command line. You can connect the printer via parallel, serial, and AppleTalk ports, and it can also support an external SCSI hard disk for font storage—an option normally used only in the Macintosh market.

You can upgrade the Silentwriter2 990's standard 2MB of RAM to a total of 4MB with a proprietary add-in board, which retails for a pricey $499 (please take note: 2MB boards for LaserJet printers typically cost $250 or less). When you add RAM, you can set the printer to partition memory so that PCL soft fonts and macros won't be cleared until you turn off the power.

With Adobe PostScript and PCL 4, respectable speeds in all modes, and automatic emulation switching, the NEC Silentwriter2 990 is certainly a good printer. But its high price makes it less attractive than some of its PCL/PostScript competitors.

FACT FILE

NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; 508-264-8000.

NEC Silentwriter2 990

List Price: $4,495; 2MB RAM upgrade, $499; second letter-size paper cassette, $69; legal-size paper cassette, $99; envelope cassette, $89.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 11 x 25 x 17 inches.

Weight: 49 lbs.

Emulations: Adobe PostScript, HP PCL 4.

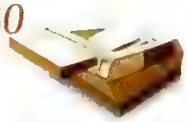
CIRCLE 547 ON READER SERVICE CARD

Eastman Kodak Ektaplus 7008	EiconLaser	Epson EPL-7000	Epson EPL-7500	Everex LaserScript LX	GCC BLP II	GCC BLP IIS	HP LaserJet IIIP	IBM LaserPrinter 5e
$1,395	$5,595	$1,399	$2,999	$1,995	$1,999	$2,899	$1,595	$1,595
9 x 15 x 16	9 x 18 x 32	8 x 20 x 25	8 x 20 x 25	9 x 25 x 16	5 x 17 x 23	5 x 17 x 23	8 x 14 x 25	12 x 14 x 21
38	42	40	40	35	23	23	22	33
Laser TEC 1306C	Laser Canon SX	Laser Minolta SP101	Laser Minolta SP101	Laser TEC 1305Z	LED array Oki Electric OL-400	LED array Oki Electric OL-800	Laser Canon LX	Laser IBM/Lexmark 4029 Model 10
8	8	6	6	6	4	8	4	5
⌟	■	■	■	⌟	⌟	⌟	■	■
1,500	4,000	6,000	6,000	1,500	2,500	2,500	3,500	4,000
1.5MB	5MB	512K	2MB	2.5MB	2MB	2MB	1MB	1MB
300 x 300	800 x 400	300 x 300	300 x 300	300 x 300	300 x 300	300 x 300	300 x 300	300 x 300
None	Intel 80960	None	Weitek XL8200	None	None	None	None	None
■	⌟	■	■	■	⌟	⌟	■	■
■	⌟	■	■	■	⌟	⌟	■	■
⌟	⌟	⌟	■	■	■	■	⌟	⌟
⌟	N/A	■	⌟	■	N/A	N/A	⌟	⌟
⌟	N/A	■	⌟	■	N/A	N/A	⌟	⌟
1	1	1	1	1	1	1	1	1
200	200	250	250	150	200	200	70	200
⌟	⌟	⌟	⌟	⌟	⌟	⌟	⌟	⌟
34	35	42	42	27	34	34	28	24
PCL 4	None	PCL 4	PCL 4	PCL 4	None	None	PCL 5	PCL 4
⌟	N/A	⌟	⌟	N/A	N/A	N/A	■	⌟
⌟	N/A	■	⌟	■	N/A	N/A	■	⌟
None	EiconScript	None	Adobe Level 1	Microsoft Interpreter	Adobe Level 1	Adobe Level 1	None	None
⌟	■	⌟	■	■	■	■	⌟	■
⌟	■	⌟	⌟	■	⌟	⌟	⌟	⌟
■	⌟	⌟	⌟	⌟	■	■	■	■

CONTINUES

OKIDATA

Okidata OL830



by Ann Sherman

The $1,999 Okidata OL830 is this roundup's only 8-page-per-minute PCL/PostScript printer with a list price below $2,000. Based on the Oki Electric OL-800 LED engine, it uses genuine Adobe PostScript (but only 17 fonts) and an HP PCL 4 emulation, with software-based automatic emulation switching. Most impressive, out of 35 desktop laser printers, it placed first in PCL graphics, beating even the PCL-only desktop laser printers. At a street price of roughly $1,400, the OL830 can't be beat for fast, inexpensive PostScript printing.

The OL830 is identical to the company's $2,599 Okidata OL840 PostScript printer (reviewed November 13, 1990), but has 18 fewer Adobe fonts, a serial and an AppleTalk interface, and most importantly a price about $1,600 dollars less than its predecessor (Okidata still markets the OL840 for $2,599). Also in Okidata's LED product line is the $999 4-ppm Okidata OL400, which remains one of the least expensive personal page printers available, selling for as little as $600.

FAST PCL GRAPHICS

The OL830 performed very well on PC Magazine Labs' speed tests—especially on PCL graphics, where it beat all the other desktop laser printers by printing a lightning-fast 3.1 graphics pages per minute. And on PostScript graphics, it tied for second place with the LaserMaster TrueTech 1000, producing a speed of 0.9 gppm.

DESKTOP LASER PRINTERS: SUMMARY OF FEATURES

Products listed in alphabetical order

	IBM LaserPrinter 6	IBM LaserPrinter 10	LaserMaster TrueTech 800/4	LaserMaster TrueTech 1000	Mannesmann Tally MT735	Mannesmann Tally MT911 PS	Microtek TrueLaser	NEC Silentwriter2 990
List price (tested configuration)	$1,895	$2,395	$3,695	$6,995	$1,295	$3,195	$2,695	$4,495
PHYSICAL CHARACTERISTICS								
Dimensions (HWD, in inches)	12 x 14 x 21	12 x 14 x 21	9 x 28 x 14	9 x 18 x 26	2 x 11 x 9	9 x 18 x 24	9 x 25 x 16	11 x 25 x 17
Weight (pounds)	33	33	24	38	8	42	35	49
ENGINE								
Engine type	Laser	Laser	Laser	Laser	Thermal	Laser	Laser	Laser
Model	IBM/Lexmark 4029 Model 20	IBM/Lexmark 4029 Model 30	Canon LX	Canon SX	Mannesmann Tally 735	Konica LP3110	TEC 1305-Z	Canon LBBP-UX
Rated speed (pages per minute)	6	10	4	8	6	10	6	8
Single-cartridge toner/developer/drum	■	■	■	■	❑	❑	❑	■
Toner capacity (copies)	4,000	4,000	3,500	3,500	150	2,000	1,500	4,000
Memory	1MB	1MB	6MB	9MB	1MB	2.5MB	2MB	2MB
Maximum resolution (horizontal by vertical dots per inch)	300 x 300	300 x 300	800 x 800	1,000 x 1,000	300 x 300	300 x 300	300 x 300	300 x 300
Controller with RISC processor	None	None	LaserMaster	LaserMaster	None	None	AMD 29000	Weitek XL8200
INTERFACES								
Parallel	■	■	❑*	❑*	■	■	■	■
Serial	■	■	❑	❑	❑	■	■	■
AppleTalk	❑	❑	❑	❑	❑	❑	■	■
Automatic interface switching	❑	❑	N/A	N/A	N/A	❑	■	❑
Simultaneously active ports	❑	❑	N/A	N/A	N/A	❑	■	❑
PAPER HANDLING								
Number of paper cassettes	1	1	2	1	1	2	1	1
Cassette capacity (sheets)	200	200	50, 250	250	80	200, 200	150	200
Duplexing	❑	❑	❑	❑	❑	❑	❑	❑
Rated maximum paper weight (pounds)	24	24	28	35	24	32	34	34
FONTS AND FEATURES								
HP PCL support	PCL 4	PCL 4	None	None	PCL 4	PCL 4	PCL 4	PCL 4
Supports scalable fonts	❑	❑	N/A	N/A	❑	❑	❑	■
Accepts HP-compatible font cartridges	❑	❑	N/A	N/A	❑	❑	❑	❑
PostScript language support	None	None	Microsoft TrueImage	Microsoft TrueImage	None	Microsoft Interpreter	Microsoft TrueImage	Adobe Level 1
Supports Type 1 fonts	■	■	■	■	❑	■	■	■
Supports automatic emulation switching	❑	❑	■	❑	❑	❑	❑	■
Accepts proprietary font cards	■	■	❑	❑	❑	■	■	❑

PC —Editors' Choice ■—Yes ❑—No * This product uses a video I/O interface.
N/A—Not applicable: The product does not have this feature.

On the PCL text speed test, the OL830 also did well, exceeding its rated engine speed by producing 8.1 ppm. Its PostScript text speed was fair, at 7.9 ppm.

For the most part, the OL830's output was superb. While it could stand a fine-tuning in contrasts at the darker end of the gray scale, the PostScript graphics image was still quite attractive.

FONTS AND FEATURES

Like the NEC Silentwriter2 990, the OL830 is bundled with *PrinterControl Panel*, a LaserTools Corp. utility that senses the change in drivers and automatically switches the mode—no hotkeys or software commands required.

The OL830 offers 17 Adobe PostScript fonts, including Helvetica, Helvetica narrow, Courier, Times Roman, and Symbol set (the first three have bold, italic, and italic-bold enhancements). You can buy an additional 18 PostScript fonts for $399. (If you don't want a serial interface, the upgraded price is still $200 less than the $2,599 OL840.) In HP mode, the printer offers 36 Bitstream fonts spanning four typefaces: Courier in 10 and 12 points, Dutch in 8 and 10 points, Line Printer, and 14.4-point Swiss. A thin slot on the side will accept two font cards at a time: You

Out of 35 desktop laser printers, the OL830 placed first in PCL graphics speed.

Okidata OL830	Panasonic KX-P4455 Laser Partner	QMS PS-815	QMS PS-815 MR	QMS PS-825	Sharp JX-9500H	Sharp JX-9500PS	Star Micronics LaserPrinter 4	Star Micronics LaserPrinter 4 StarScript	Tandy LP 950
$1,999	$2,995	$4,995	$5,495	$5,995	$1,599	$2,849	$1,395	$1,995	$1,599
6 x 18 x 18	15 x 28 x 17	9 x 18 x 25	9 x 18 x 25	12 x 18 x 25	11 x 13 x 14	11 x 13 x 14	9 x 25 x 14	9 x 25 x 14	11 x 13 x 15
37	60	44	44	55	33	33	25	25	33
LED	Laser	Laser	Laser	Laser	Laser	Laser	Laser	Laser	Laser
Oki Electric OL-800	Matsushita KX-P4455	Canon-SX	Canon-SX	Canon-SX	Sharp JX-95	Sharp JX-95	Canon LX	Canon LX	Sharp JX-95
8	11	8	8	8	9	6	4	4	6
❑	❑	■	■	■	❑	❑	■	■	❑
2,500	5,000	4,000	4,000	4,000	3,000	3,000	3,500	3,500	3,000
2MB	2MB	2MB	6MB	2MB	512K	2.5MB	1MB	2MB	512K
300 x 300	300 x 300	300 x 300	600 x 600	300 x 300	300 x 300	300 x 300	300 x 300	300 x 300	300 x 300
None	None	None	None	None	None	None	Intel 80960	Intel 80960	None
■	■	■	■	■	■	■	■	■	■
❑	■	■	■	■	■	❑	■	■	■
❑	■	■	■	■	❑	❑	❑	■	❑
N/A	❑	■	■	■	❑	N/A	❑	❑	■
N/A	❑	■	■	■	❑	N/A	❑	❑	❑
1	2	1	1	2	1	1	1	1	1
200	250, 250	200	200	200, 200	250	250	50	50	250
❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
24	24	36	36	36	34	34	28	28	35
PCL 4	PCL 4	PCL 4	PCL 4	PCL 4	PCL 4	PCL 4	PCL 4	PCL 4	PCL 4
N/A	N/A	❑	❑	❑	❑	❑	❑	❑	❑
❑	❑	■	■	■	❑	❑	■	■	■
Adobe Level 1	Adobe Level 1	Adobe Level 1	Adobe Level 1	Adobe Level 1	None	Adobe Level 1	None	Star Micronics StarScript	None
■	■	■	■	■	❑	■	❑	■	❑
■	❑	■	■	■	❑	❑	❑	❑	❑
■	■	■	■	■	■	■	❑	❑	■

ENDS

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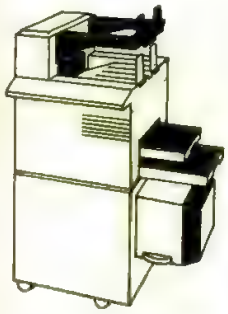

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EN ADVANTAGE.

Okidata OL830

pay $395 for each additional PostScript card and $195 for each Bitstream card. The OL830 ships with 2MB of RAM, and Okidata offers a $399 2MB RAM-board option to accommodate soft fonts.

The printer's 8.5- by 11-inch paper cassette has room for 200 sheets, and the paper flows smoothly onto a 200-sheet-capacity top output tray. For specialty paper such as envelopes, labels, and transparencies, the printer offers a straight rear-exit path. Envelopes and labels were on hand for testing and zipped through without a jam, tear, or peel. Okidata offers an optional $349 second paper-tray mechanism, and additional trays, including those for envelopes, are available for $89 apiece.

A 32-character LCD lets you set the default emulation, the interface (if you've purchased the $200 serial option), the paper cassette, and the font (HP mode), among other features. Printer setup is a snap; it should take a novice less than 10 minutes. The ease is due mainly to the detailed but clear instructions.

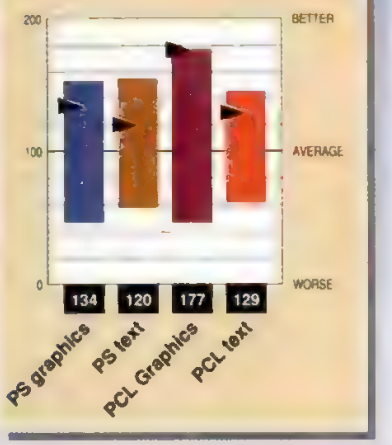
The printer is protected by a one-year parts-and-labor warranty, and the LED printhead itself is guaranteed for five years.

What there is to say against the OL830 is minor. First, it might have an easier time nibbling at the Hewlett-Packard Co. monopoly if it accepted HP-compatible font cartridges. In addition, Okidata keeps the image-drum and toner separate rather than combining them.

With the OL830, you won't get all 35 PostScript fonts, a serial port, a single-piece photoconductor system, or the ability to use HP-compatible font cartridges. But at a street price of about $1,400, you will be getting the best inexpensive PCL/PostScript printer available. And you will be getting the fastest PCL graphics desktop laser printer at any price.

Okidata OL830

TEST RESULTS



PCL and PostScript scores

In Short: The best choice for inexpensive PostScript, the $1,999 Okidata OL830 is the only below-$2,000 PostScript printer to use an 8-ppm engine (Okidata's own LED engine). In HP PCL graphics, it really shone, beating every other desktop laser. And it uses genuine Adobe PostScript.

FACT FILE

Okidata, 532 Fellowship Rd., Mt. Laurel, NJ 08054; 800-654-3282, 609-235-2600.

EDITORS' CHOICE

Okidata OL830

List Price: $1,999; 2MB RAM upgrade, $399; PostScript Essentials font card, $399; additional PostScript font cards, $395 each; additional Bitstream font cards, $195 each; additional paper-cassette mechanism, $349; second letter-size paper cassette, $89; legal-size paper cassette, $89; executive-size paper cassette, $89; A4-size paper cassette, $89; envelope cassette, $89; AppleTalk/RS-232C interface, $199.

Standard Warranty: One year on parts and labor; five-year warranty on the printhead.

Dimensions (HWD): 6 x 18 x 18 inches.

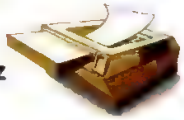
Weight: 37 lbs.

Emulations: Adobe PostScript, Diablo, HP PCL 4.

CIRCLE 548 ON READER SERVICE CARD

PANASONIC COMMUNICATIONS & SYSTEMS CO.

Panasonic KX-P4455 Laser Partner



by Wendy Dugas Pérez

The top-performing desktop laser printer in PostScript text mode, the dual-bin Panasonic KX-P4455 Laser Partner adds Adobe PostScript to the Panasonic KX-P4450i Laser Partner we reviewed last year (November 13, 1990). Based on a Matsushita 11-page-per-minute laser engine, the new printer includes genuine Adobe PostScript, Diablo 630, and HP PCL 4 emulations. Originally priced at $3,495, it dropped to $2,995 in August, and you can probably find it for as low as $1,500. In addition to its low price, the KX-P4455's swift speed and quality output help offset its bulkiness and the fact that it still uses bottled toner.

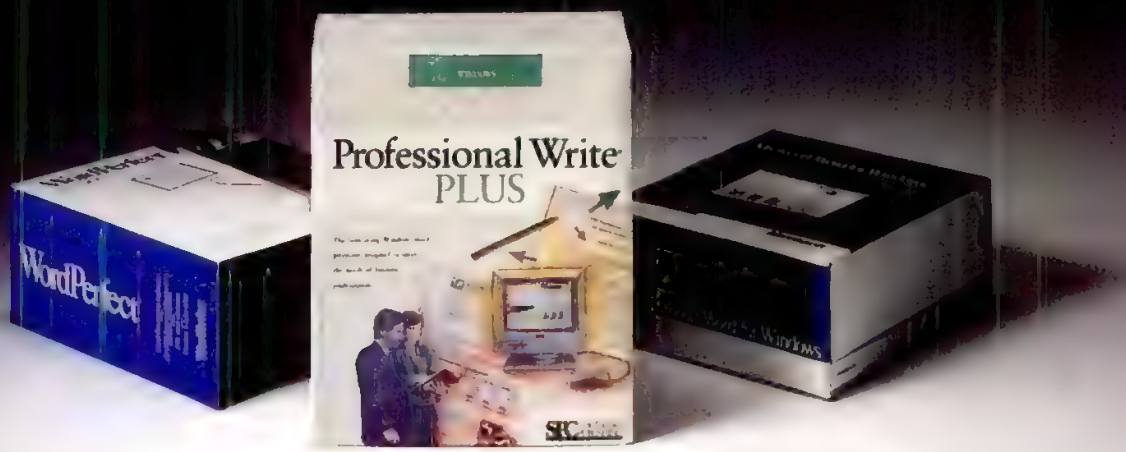
MATSUSHITA 11-PPM ENGINE

Installation is easy and similar to other printers, with nothing unusual except that Panasonic Communications & Systems Co. has still not given up on using bottles filled with toner that must be emptied into the printer. The use of a standard cartridge would eliminate the threat of spilling the toner, or worse yet inhaling it. The toner is rated at 5,000 copies per bottle, and when you need to purchase more, you can do so for $45. You can replace the photoconductor, which has an expected life of 13,000 copies, for $190.

Panasonic KX-P4455

With a duty cycle of 5,000 pages, the Panasonic KX-P4455 Laser Partner has a total life of around 300,000 pages. Not only are parallel and serial interfaces provided, but an AppleTalk port is also

In this year's word processing shootout, we laid some old assumptions to rest.



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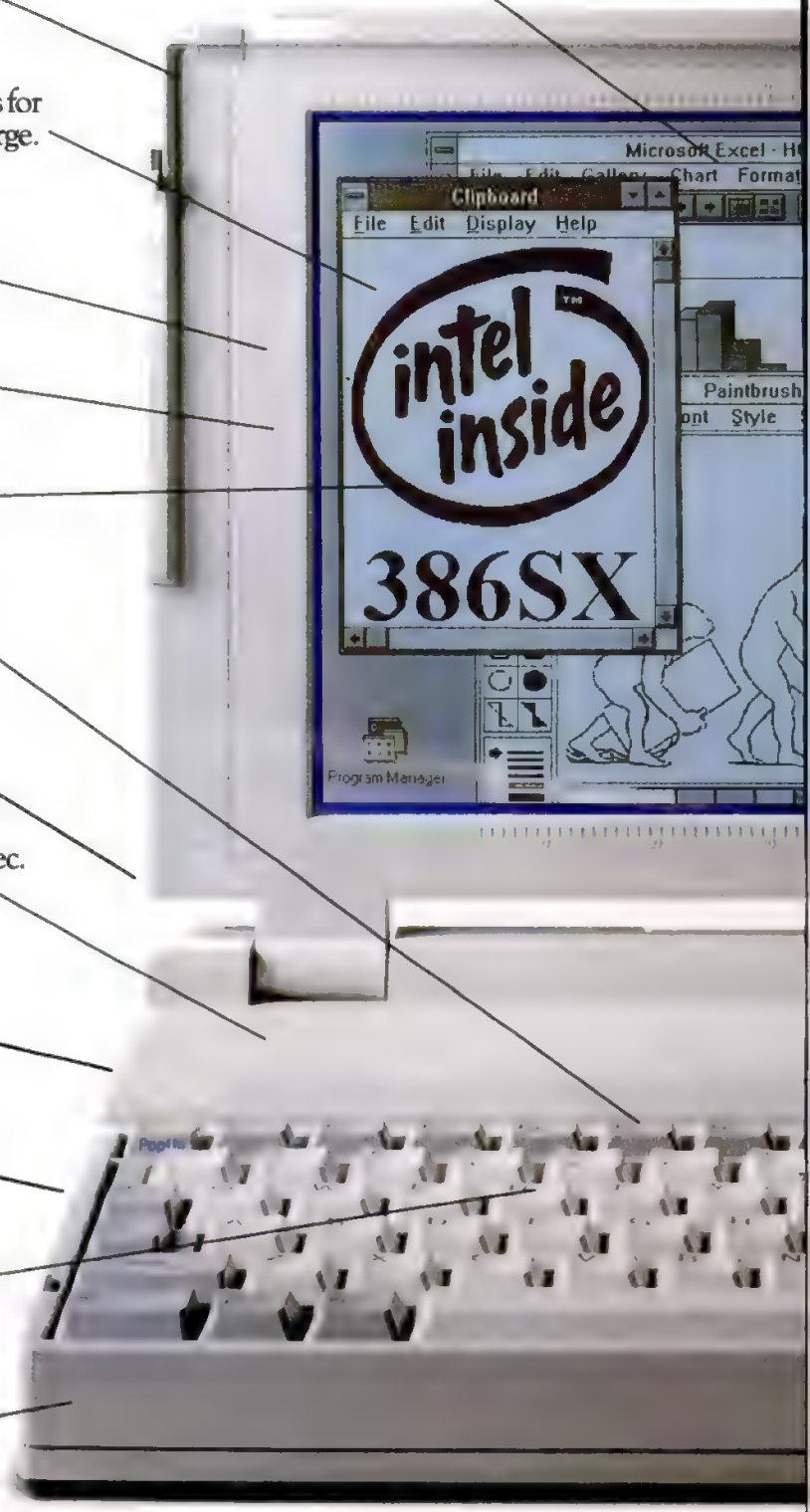

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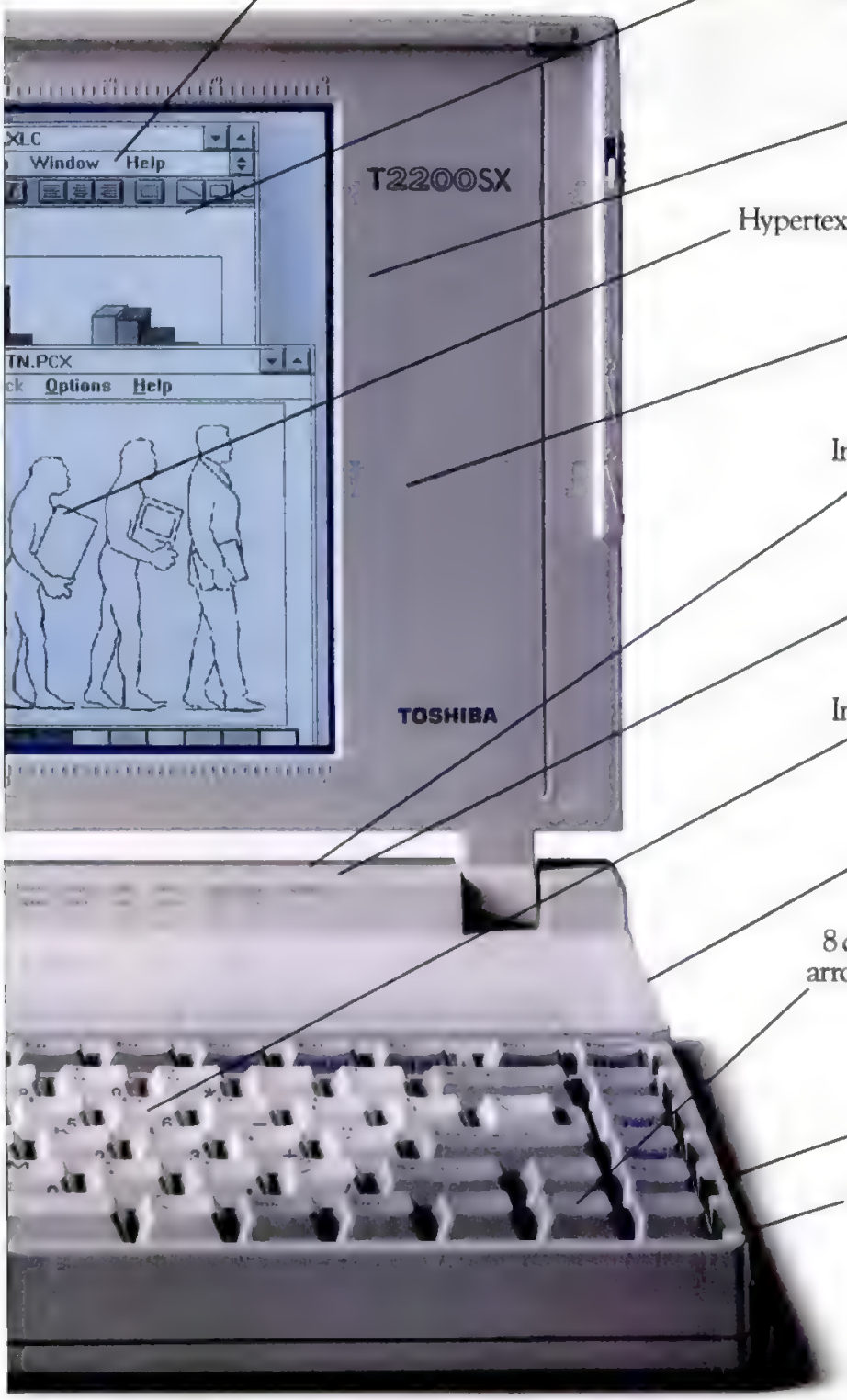

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CIRCLE 379 ON READER SERVICE CARD

included. Panasonic provides a one-year parts-and-labor warranty.

With two 250-sheet paper cassettes capable of handling 16- to 24-pound paper, the KX-P4455 is able to handle your heavy printer loads. Although both the included paper cassettes are letter-size, you can purchase a legal-size paper cassette for $59 and an envelope cassette for $85. The printer is capable of 250-sheet face-down collated output. Its 15-character LCD and control panel enable you to select such things as enhancements, the I/O interface, a foreign language, the emulation, fonts, the number of copies, the cassette, and format.

The KX-P4455 comes well equipped with a standard 2MB of RAM. If your printing needs require more, a 2MB upgrade is available for $945. The printer is on the large side, measuring 15 by 28 by 17 inches with all paper cassettes and trays installed, and it weighs in at a hefty 60 pounds.

Panasonic includes plenty of fonts—39 scalable Adobe fonts for PostScript (including all 35 Apple LaserWriter and IBM Resident Adobe Fonts), as well as 26 internal fonts for PCL. There is space for one of six font cards (which are only software-compatible with HP's font cartridges) at $145 apiece. The printer is not capable of switching emulations automatically.

TOP POSTSCRIPT TEXT SCORE

With a PostScript text speed of 10.2 ppm, the KX-P4455 beat all the other desktop laser printers that came standard with PostScript compatibility. In PCL mode, it was much slower, bringing in a text speed of 8.6 ppm.

The KX-P4455 did not distinguish itself on our graphics speed tests. In PostScript mode, it managed a respectable 0.8 graphics pages per minute, but in PCL mode it managed only 1.4 gppm, slower than we would expect from its 11-ppm rated engine speed.

Its output quality was fine, but we encountered the same problem with the KX-P4455 on as we did on the KX-P4450i and the 8-ppm Panasonic KX-P4420 last year: The Panasonic printers cannot handle the 0-byte image on our PCL 4 compatibility test: They print either the bottom third or the top third of the page. Although Panasonic assured us last year that a free ROM upgrade would fix the problem, Panasonic was once again unable to supply us with one.

The low street price and solid PostScript graphics and text speed make the Panasonic KX-P4455 Laser Partner an attractive desktop laser printer, if you are willing to overlook the large size and the messy toner bottle, as well as its glitch on the PCL 4 compatibility test.

FACT FILE

Panasonic Communications & Systems Co., Two Panasonic Way, Secaucus, NJ 07094; 201-348-7000.

Panasonic KX-P4455 Laser Partner

List Price: $2,995; 2MB RAM upgrade, $945; font cards, $145 each; second letter-size paper cassette, $49; legal-size paper cassette, $59; envelope cassette, $85.

Standard Warranty: One year on parts and labor.

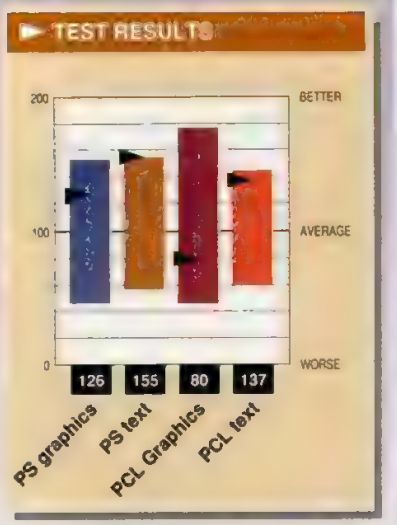
Dimensions (HWD): 15 x 28 x 17 inches.

Weight: 60 lbs.

Emulations: Adobe PostScript, Diablo, HP PCL 4.

CIRCLE 612 ON READER SERVICE CARD

Panasonic KX-P4455 Laser Printer

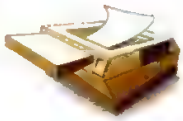


PCL and PostScript scores

In Short: Based on the 11-ppm Matsushita engine, the $2,995 Panasonic KX-P4455 Laser Printer landed in first place on our PostScript text speed test. It uses genuine Adobe PostScript and has an HP PCL 4 emulation. On the negative side, it uses bottled toner.

QMS INC.

QMS PS-815
QMS PS-815 MR
QMS PS-825

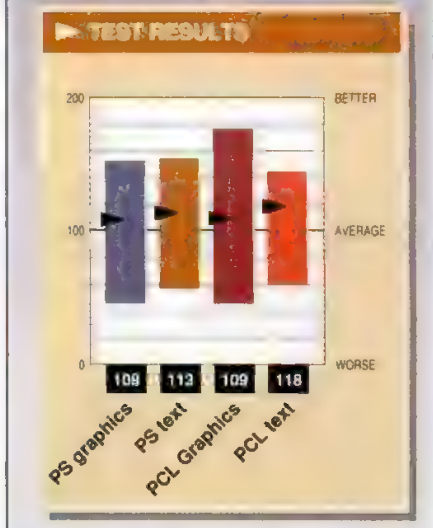


by Bruce Brown

With list prices ranging from $4,995 to $5,995, QMS charges more for its three new 8-page-per-minute Canon SX engine–based laser printers than you would expect for regular PCL/PostScript machines. But the QMS PS-815, QMS PS-815 MR, and QMS PS-825 provide special features—such as automatic emulation and interface switching, a resolution of 600 dots per inch, and dual-cassette printing—that may make up for the high prices. You can expect discounts to start at 20 percent off the list prices. The QMS PS-series printers are best used with small workgroups or in mixed-platform environments where their features will pay their way.

All three QMS PS printers use the company's Emulation Sensing Processor

QMS PS-815



PCL and PostScript scores

In Short: The QMS PS-815 has lots of high-quality features: an 8-ppm Canon SX engine, Adobe PostScript, HP PCL 4, automatic interface switching among three ports, and respectable speeds. But at $4,995, it also carries a high price.

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For more information

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(ESP) technology, which automatically detects what printer language is being used and automatically switches among emulations. The standard emulations are Adobe PostScript and HP PCL 4, and an HPGL emulation card is a $295 option. The printers also include parallel, serial, and AppleTalk interfaces that can simultaneously receive data from three computers. Both ESP and simultaneous I/O first appeared in QMS's 4-ppm QMS PS-410 (which we reviewed last year, and which is still being sold for $2,795).

The PS-815 lists for $4,995 and comes with 2MB of RAM and a single paper cassette; the dual-cassette (but not double-sided-printing) PS-825 lists for $5,595 and also comes with 2MB of RAM. The hottest-version PS-815 MR, with 6MB of RAM and selectable 600-dpi resolution, lists for $5,495.

QMS PS-815

The QMS PS-815 is the base-priced model of the vendor's SX engine–based printers, and it uses QMS's latest controller, the QMS ASAP III (Advanced System Architecture for PostScript). With a list price of $4,995 and an estimated street price of just under $4,000, the PS-815 is a bit pricey, though it does give you automatic emulation sensing along with simultaneous three-port I/O in QMS's least expensive package.

The font set includes 45 Adobe typefaces in PostScript mode and standard HP Courier and Line Printer fonts in HP mode. There are two slots for optional font cartridges (QMS sells ten different font cartridges for $225 each). The PS-815 does not accept HP cartridges but will use downloaded HP-compatible soft fonts. The QMS PS-815 comes with *PS Executive Series*, a printer utility package that includes a printer configuration program and PostScript drivers for *Microsoft Windows* and other programs. A controller upgrade to MR-level 600-dpi-resolution printing will be available for the PS-815, but QMS had not set the price for it at press time.

The PS-815 performed similarly to other Canon SX–based printers, with text speeds of 7.4 ppm and 7.5 ppm in PCL and PostScript modes, respectively. In graphics mode, its scores were respectable: 1.9 graphics pages per minute in PostScript mode and 0.7 gppm in PCL mode. Its scores were almost identical to those of the PS-815 MR and PS-825.

The new QMS printers use ESP technology, which automatically switches among emulations. The hottest-version QMS PS-815 MR prints 600-dpi output.

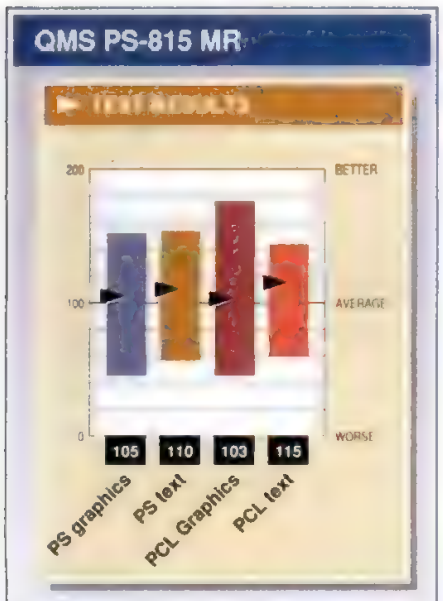
You can upgrade the standard 2MB of RAM to a maximum of 8MB. The list-price upgrade costs are $495 for 2MB, $795 for 4MB, and $995 for 6MB—hefty prices for an option you will likely consider if you attach the printer to more than one computer. You can configure the printer memory into separate buffers for each of the three I/O ports, allowing more than one computer to send data to the printer at once. If you are going to print PostScript files and use more than one computer with any other QMS-PS printer, you might as well upgrade the memory to the 8MB maximum if you intend to use the printer fairly often.

The QMS PS-815 uses a single 200-sheet paper cassette, with optional letter-size, legal-size, A4-size, A5-size, and envelope cassettes available for $75 each. If you don't want to add paper often, a $795 large-capacity paper cassette is an attractive option. As with other Canon SX–based printers, paper can follow a straight-through paper path for face-up output or a C-shaped path for face-down, collated output.

The single-piece photoconductor system lists for $130 and is rated at 4,000 copies. Changing cartridges is such an easy one-step process that you would have to make an effort to do it incorrectly.

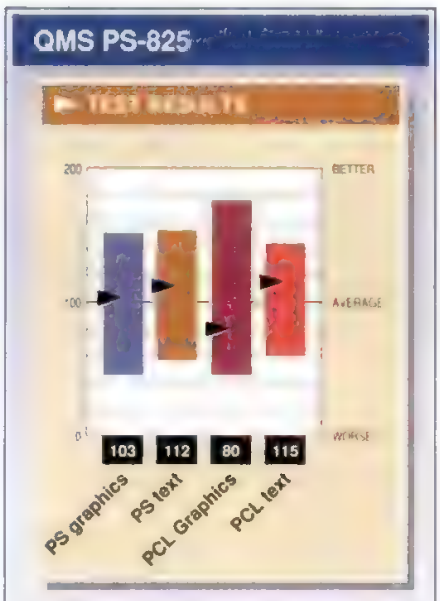
QMS PS-825

The only difference besides price between the PS-815 and PS-825 is a second paper cassette positioned under the first cas-



PCL and PostScript scores

In Short: The QMS PS-815 MR adds 600-dpi resolution to the features of the QMS PS-815, without sacrificing speed. Although an exciting, well-built printer, it is too expensive, at $5,495.



PCL and PostScript scores

In Short: The $5,995 QMS PS-825 is identical to the QMS PS-815, except that it adds a paper cassette (but no duplexing capability).

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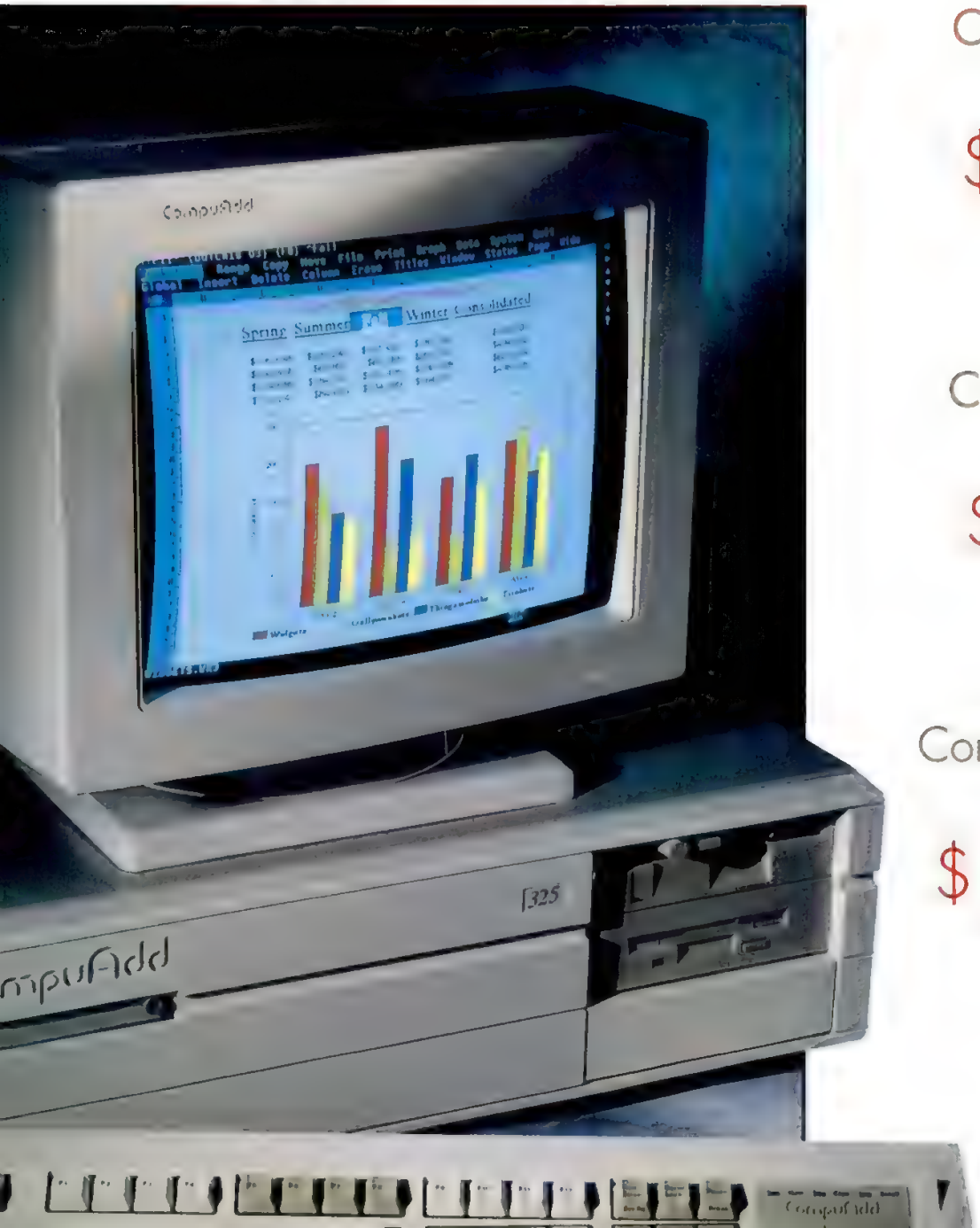

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MGA	$1995	$2195
High-Resolution VGA	$2295	$2495

PC Magazine chose the 333 as a finalist in its Technical Excellence Awards. Two 16-bit expansion "hot slots" are provided for the HardCache/ESDI controller and Hi-Rez VGA graphics card. Plug them in for spectacular data transfer and video performance! The optional 640KB SRAM card puts DOS and DOS-based applications into true 0 wait-state memory.

Monitor and Hard Drive Options

	80MB	120MB
333		
MGA	$2695	$2795
High-Resolution VGA	$2995	$3095

The expanded 32-bit EISA bus lets you access any memory or peripheral device installed on the system — regardless of bus width! Use your old 16-bit peripheral cards alongside new 32-bit EISA cards with no compatibility problems. A "hot slot" for the Hi-REZ VGA controller and a specially designed optional cache module move your data through at lightning speed.

Monitor and Hard Drive Options

	80MB	120MB
433E		
MGA	$3995	$4095
High-Resolution VGA	$4295	$4395

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sette, adding 3 inches to the printer's height. Expect the $5,995 printer to retail somewhere under $5,000. All the other bells and whistles of the PS-815 are here, of course, but the second paper cassette doesn't seem worth $1,000, unless your application clearly calls for it.

The best application for the PS-825 is a setting where two types of paper, typically letterhead and follow-sheets, are used so often that changing cassettes is a big nuisance. In that case, the two-cassette model makes sense. You can use the printer's control panel to select the cassettes, the software drivers, user-entered printer escape codes, or the *PS Executive Series* utility. For long single-paper-type printing jobs, the two cassettes can be chained so that the second one takes over when the first is empty.

If your only reason for buying the two-cassette printer is for long print runs, then the $795 large-capacity paper cassette makes more sense than the $1,000 difference between the PS-815 and PS-825. If your printing volume is even higher, you should consider buying the PS-825 and the large-capacity paper cassette.

If you regularly use letterhead and follow-sheets or another combination of two paper types, the QMS PS-825 is a reasonable time-saver. Before you jump for this model, however, consider the more expensive PS-825 MR, which for $500 extra gives you a total of 6MB of RAM and selectable 600-dpi resolution—less expensive than buying 4MB more for a regular PS-825.

QMS PS-815 MR

"MR" stands for multiple resolution, which is what you get with the QMS PS-815 MR. This printer lists for $5,495 and should have a street price in the low-to-mid-$4,000 range. It comes standard with 6MB of RAM and a resolution of either 300 or 600 dots per inch (which you select via the front control panel or software). The QMS PS-825 MR, which has two paper cassettes, lists for $6,495; we were not able to test this latter model, but it is otherwise just like the PS-825 with 6MB RAM and the higher-resolution option.

Other than 6MB of RAM and selectable 600-dpi output, the PS-815 MR is just like the PS-815, with the same emulations and fonts and the same paper-handling features. The 6MB minimum is essential because of the memory space needed for 600-dpi print files (an extra $495 for 2MB takes the printer to its 8MB maximum). The memory is also used to keep speed up in high-resolution mode.

The great jump to 600 dpi while keeping the same Canon SX engine used by QMS's other 8-ppm printers raises concerns about print quality and printing speed. Happily, our concerns disappeared when we examined the printer's speed test scores. Its graphics and text samples were both noticeably sharper in the higher resolution. QMS's proprietary ASAP III controller board includes the necessary magic to keep the speed up to the same level as when printing at 300 dpi.

Improved resolution without a sacrifice in speed makes the $500-more MR version of the PS-815 the printer of choice. With all other options and features the same as its sister printer, the single-bin 8-ppm PS-815 MR is the PostScript printer to buy.

With automatic emulation switching between Adobe PostScript and PCL 4, automatic interface switching among its three ports, and respectable speeds, all three QMS printers are worthy if rather pricey choices. The QMS PS-815 MR, with its 600-dpi resolution and 6MB of RAM, is a particularly interesting choice. But keep in mind that IBM Corp. offers the same capability for its LaserPrinter 10, which is faster, is comparably configured, and has a list price that is $1,400 lower.

FACT FILE

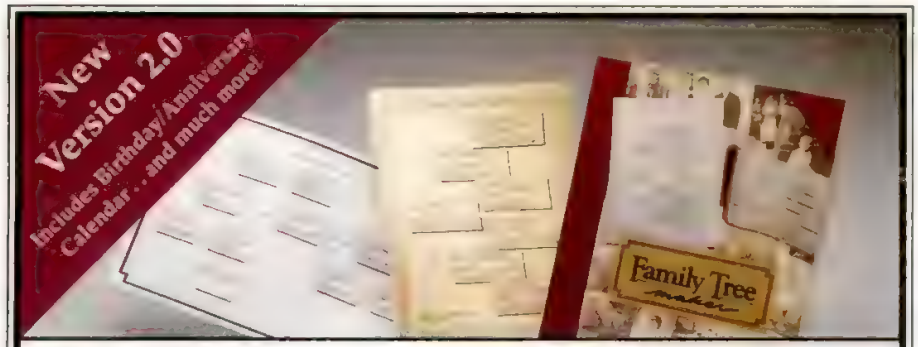
QMS Inc., One Magnum Pass, Mobile, AL 36618; 800-523-2696, 205-639-4400.

QMS PS-815
List Price: $4,995; 2MB RAM upgrade, $495; 4MB RAM upgrade, $795; 6MB RAM upgrade, $995; HPGL emulation card, $295; font cards, $225; large-capacity letter-size paper cassette, $795; legal-size paper cassette, $75; executive-size paper cassette, $75; A4-size paper cassette, $75; envelope cassette, $75.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 9 x 18 x 25 inches.
Weight: 44 lbs.
Emulations: Adobe PostScript, HP PCL 4.

QMS PS-815 MR
List Price: $5,495; 2MB RAM upgrade, $495; HPGL emulation card, $295; font cards, $225 each; large-capacity letter-size paper cassette, $795; legal-size paper cassette, $75; executive-size paper cassette, $75, A4-size paper cassette, $75; envelope cassette, $75.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 9 x 18 x 25 inches.
Weight: 44 lbs.
Emulations: Adobe PostScript, HP PCL 4.

QMS PS-825
List Price: $5,995; 2MB RAM upgrade, $495; 4MB RAM upgrade, $795; 6MB RAM upgrade, $995; HPGL emulation card, $295; font cards, $225 each; large-capacity letter-size paper cassette, $795; legal-size paper cassette, $75; executive-size paper cassette, $75; A5-size paper cassette, $75; envelope cassette, $75.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 12 x 18 x 25 inches.
Weight: 55 lbs.
Emulations: Adobe PostScript, HP PCL 4.

CIRCLE 613 ON READER SERVICE CARD



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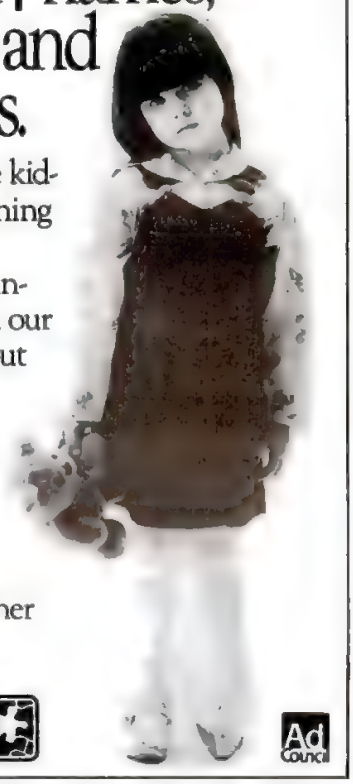

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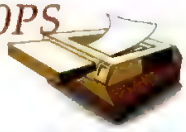


by Bruce Brown

Sharp Electronics Corp.'s cube-like JX-9500-series laser printers use Sharp's own 6-ppm laser engine in a very small printer size (11 by 13 by 14 inches). The $1,599 Sharp JX-9500H implements special circuitry to increase the engine performance to 9 ppm. It comes with HP PCL 4 and typically sells for under $1,000 after discounting—a bargain for such a high speed.

The Sharp JX-9500PS adds Adobe PostScript but subtracts the extra speed. For a 6-ppm printer, its speeds are perfectly respectable, but the list price is $2,849 (and the street price close to $1,800). You can find cheaper, faster PostScript printers.

SHARP ENGINE

Sharp is one of the few laser printer vendors that uses its own laser engine. This engine is used by some other vendors, including Dataproducts Corp. and Tandy Corp. The other printer in Sharp's 6-ppm laser-engine lineup is the low-end JX-9500 ($1,399 list), which differs from the JX-9500H only in lacking the high-speed boost.

Standard with all of the Sharp JX-9500-line printers is a generous 250-sheet paper cassette, which fits totally inside the printer, preserving the unit's trim outside dimensions. For most flexible printing tasks, you can add the optional lower 250-sheet cassette unit (which costs $345) and 40-piece envelope feeder (which retails for $325) to allow the convenience of three-bin operation.

The printers use three replaceable imaging components. The photoconductor drum is good for 50,000 copies and lists for $149. The developer kit, rated for 25,000 sheets, costs $120. And the toner cartridge, which is the component you're most likely to spill if you're not careful, lasts for roughly 3,000 copies and costs $59. Replacements are not hard to install when you need them—they just slide into place—but keeping track of three types of replaceables seems unnecessary when other engines can work with a single-piece system.

9-PPM PCL PRINTER

The JX-9500H is a terrific deal for the text-printing speed and emulations it provides, especially if space is a primary consideration. On PC Magazine Labs' text speed test, it ran at 8.5 ppm, almost achieving its boosted engine rating of 9 ppm. At 1.4 gppm on our graphics speed test, it was less impressive. Since most uses for this printer are likely to be text-based, the speed enhancement pays off where it counts.

The list of emulations includes all the standards short of PostScript. The JX-9500H has emulation modes for Diablo, Epson FX, HP PCL 4, IBM Graphics Printer, and IBM Proprinter. You would have to look hard to find a text-based application that doesn't support at least one of those printer modes. Unfortunately, the selection of resident fonts is not as impressive, with just Courier and Line Printer in HP mode. There are two font card slots, for which Sharp sells Diablo and HP-compatible soft fonts listing for $195 each.

The JX-9500H comes with 512K RAM standard; this can be expanded to a maximum of 4.5MB, but the expansion is costly: $519 for 1.5MB, $929 for 2.5MB, and $1,699 for 4MB. If you're going to upgrade the memory, you should do so at the time of purchase when you can hope to get a better discount on the upgrade price. Both parallel and serial printer interfaces are standard on the JX-9500H.

THE 6-PPM POSTSCRIPT/ PCL PRINTER

The Sharp JX-9500PS does not have the JX-9500H's 9-ppm boosting circuitry, but it does have true Adobe PostScript mode with 35 resident scalable PostScript fonts and 1.5MB standard memory.

Besides PostScript, the only emulation included with the JX-9500PS is HP PCL 4, with the standard set of HP resident fonts. Font cards with HP-compatible soft fonts cost $195 each. This PostScript laser does not include the Diablo, Epson, and IBM emulation modes found in the other JX-9500 series printers. Sharp's decision makes sense, since those in the market for PostScript printers are less likely to need to emulate dot matrix or letter-quality impact printers.

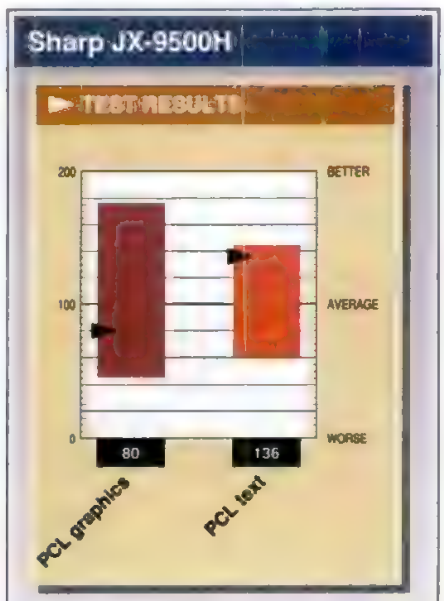
Less clear is the reason for the dearth of interfaces. The JX-9500PS comes with only a parallel port. A serial interface board costs $79, and a combination AppleTalk and serial interface board lists for $145.

The JX-9500PS proved a solid performer for its class. In PostScript mode the printer printed 6.5 ppm on our text speed test and 0.6 gppm on our graphics speed test. The PCL results were 6.5 ppm in text and 2.0 gppm in graphics mode.

The JX-9500PS's 2.5MB of RAM can be increased to a maximum of 4.5MB with up to three 1MB memory expansion cards, which cost $345 each. While this is a better deal per megabyte than the memory cards for the JX-9500H, the upgrade is fairly expensive.

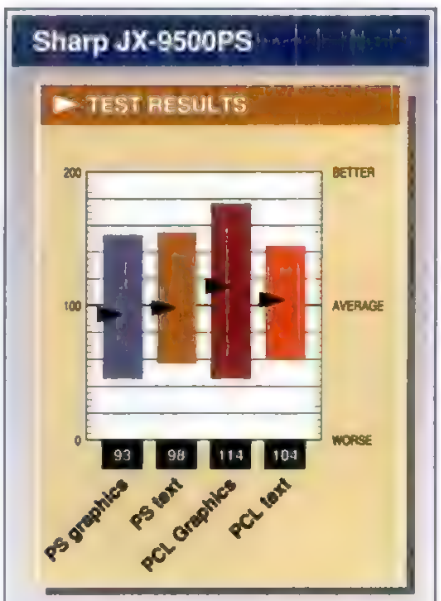
Sharp's two-year warranty is fulfilled by authorized dealers and service centers. Sharp sells laser printers both through the NOMDA office-machinery reseller channel and through computer specialty dealers.

With solid speed and a low $1,000 street price, the 9-ppm Sharp JX-9500H is a good value. But even with Adobe PostScript, the $1,800 street price of the 6-ppm Sharp JX-9500PS is less competitive.



PCL scores

In Short: Based on a Sharp engine, the $1,599 Sharp JX-9500H carries a low street price, around $1,000, and provides HP PCL 4 and quick 9-ppm output. One drawback is the lack of a PostScript upgrade.



PCL and PostScript scores

In Short: Although it uses the same engine as the 9-ppm Sharp JX-9500H, the Sharp JX-9500PS drops down to 6 ppm. And although it uses genuine Adobe PostScript, you can find faster, less expensive PostScript printers than this $2,849 model.

FACT FILE

Sharp Electronics Corp., Sharp Plaza, Mahwah, NJ 07430; 800-237-4277, 201-529-8200.

Sharp JX-9500H

List Price: $1,599; 1.5MB RAM upgrade, $519; 2.5MB RAM upgrade, $929; 4MB

RAM upgrade, $1,699; font cards, $195 each; second letter-size paper cassette, $345; envelope cassette, $325.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 11 x 13 x 14 inches.
Weight: 33 lbs.
Emulations: Diablo, Epson FX, HP PCL 4, IBM Graphics Printer, IBM Proprinter.

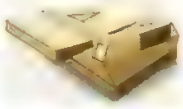
Sharp JX-9500PS
List Price: $2,849; 1MB RAM upgrade, $345; font cards, $195; second letter-size paper cassette, $345; envelope cassette, $325; serial interface board, $79; AppleTalk and serial interface board, $145.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 11 x 13 x 14 inches.
Weight: 33 lbs.
Emulations: Adobe PostScript, Diablo, Epson FX, HP PCL 4, IBM Graphics Printer, IBM Proprinter.

CIRCLE 615 ON READER SERVICE CARD

STAR MICRONICS AMERICA INC.

Star Micronics LaserPrinter 4

Star Micronics LaserPrinter 4 StarScript

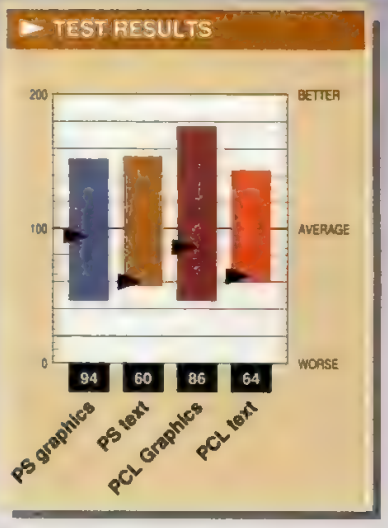


by Bruce Brown

Star Micronics America sells two laser printers, both based on the 4-ppm Canon LX laser engine used in the HP LaserJet IIP: the $1,395 LaserPrinter 4 with HP PCL 4 and the $1,995 LaserPrinter 4 StarScript. Both use a RISC processor and provide unbeatable compatibility with the LaserJet IIP. At a list price of $850, the PCL printer is a good deal. But the PCL/PostScript printer lacks genuine Adobe PostScript and came in behind other below-$2,000 PostScript printers on our tests, which makes its $1,200 street price less alluring.

Both printers can use the paper-feed-

Star Micronics LaserPrinter 4 StarScript



PCL and PostScript scores

In Short: One of only five below-$2,000 printers to provide PostScript compatibility (through Star Micronics' StarScript PostScript interpreter), the $1,995 Star Micronics LaserPrinter 4 StarScript is not the fastest, though it may be the least expensive.

All New

High Resolution PostScript

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- 135 Premium fonts
- AFM™ for instant access to all your fonts
- Fast PostScript® printing

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- AFM for instant access to all your fonts
- Fast PostScript printing

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- Fast PostScript printing
- AFM for instant access to all your fonts

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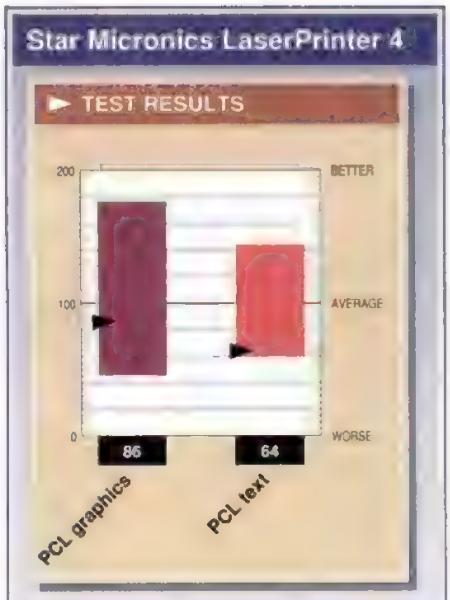

PCL scores

In Short: The $1,395 Star Micronics LaserPrinter 4, based on the 4-ppm Canon LX engine, provides HP PCL 4 superb Hewlett-Packard hardware compatibility, and a RISC processor. With a street price of $850, this printer offers an attractive value.

ing options, toner cartridge, and font cartridges used with the HP LaserJet IIP. This level of printer compatibility makes it relatively easy to find replacement toner cartridges or paper cassettes.

The one weak part of the Star Micronics laser printers is the limited standard paper-feeding system. The printers come equipped with only a single 50-sheet paper input tray. The optional 250-sheet lower paper cassette, which also allows dual-bin operation, is a $195 option and is recommended. The lower cassette bin comes with a letter-size cassette. Other options include an extra letter-size cassette for $69, a legal-size cassette for $85, an executive-size cassette for $79, and an envelope cassette for $109.

4-PPM PCL ONLY

The LaserPrinter 4 is a candidate for low-end laser printer buyers who want to get the most for their money. Whether used in a small business or a home office, the LaserPrinter 4 is a natural choice when the budget for a laser is restricted but logical and physical compatibility with Hewlett-Packard are important.

the LaserPrinter 4 is a natural printer to consider when your budget is restricted.

In addition to LaserJet IIP compatibility, the LaserPrinter 4 has an Epson FX emulation mode. In HP mode there are just the two standard resident font families, Courier and Line Printer, but also included is the UDP Turbo25 font cartridge, which includes 151 fonts with drivers for major applications programs.

On our speed tests, the LaserPrinter 4 scored typically for a Canon LX–based printer. On text, it did an even 4.0 ppm; on graphics, 1.5 gppm. Our tests do not fully exercise the RISC processor; on more-complicated files, we would expect to see a speed boost.

Standard memory in the LaserPrinter 4

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- AFM for instant access to all your fonts

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- Not all your work fits onto an 8 1/2 x 11-inch page. With paper sizes up to 11 x 17-inches, LaserMaster can fit your needs.
- Sometimes you need *just* the right look for your message. That's why we include 35 standard PostScript fonts and 100 premium Type 1 fonts, plus you can easily add more.
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Dept 426

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CIRCLE 195 ON READER SERVICE CARD

is 1MB. Memory upgrade options are available in increments of 1MB ($299), 2MB ($499), and 4MB ($999). Typical printer memory options are expensive, so buy what you need in the beginning to take advantage of good discounting. The maximum memory is 5MB.

Parallel and serial interfaces are standard on the LaserPrinter 4. Circuitry is included for an AppleTalk interface, but to use it you need to buy a proprietary PostScript-compatible board for $399 and at least a 1MB RAM upgrade board.

4-PPM POSTSCRIPT

The Star Micronics LaserPrinter 4 StarScript is one of only five PostScript-compatible printers in this roundup with sub-$2,000 list prices, but it is not the fastest, and it does not use genuine Adobe PostScript. It does come with HP PCL 4 and Epson FX compatibility.

Since the printer uses the same case and laser engine as the LaserJet IIP, its compatibility goes further than just command codes and soft fonts. As with the other LaserPrinter 4, LaserJet IIP font cartridges, paper cassettes, and toner cartridges work with the StarScript as well. One component missing from the StarScript is the Turbo25 font cartridge included with the regular LaserPrinter 4.

Standard memory for the StarScript is 2MB, with $499 2MB and $999 4MB memory upgrade options. The maximum memory is 6MB. Parallel, serial, and Apple-Talk interfaces are standard, and the active interface is chosen via a simple-to-use control panel with a 16-character LCD screen for menu setup selections.

Star Micronics printers are sold through major distributors and are available from computer dealers and mail-order sources throughout the country. The standard two-year warranty is honored by authorized dealers and service centers.

Known best for very inexpensive full-featured dot matrix printers, Star Micronics continues the tradition in its laser line. Both of its 4-ppm offerings have low list prices and superb HP compatibility. Because you can get faster printers with true Adobe PostScript for around the same amount of money, the PCL-only LaserPrinter 4 is more attractive than its PostScript-compatible StarScript sibling.

FACT FILE

Star Micronics America Inc., 420 Lexington Ave., #2702, New York, NY 10170; 800-447-4700, 212-986-6770.

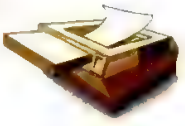
Star Micronics LaserPrinter 4
List Price: $1,395; 1MB RAM upgrade, $299; 2MB RAM upgrade, $499; 4MB RAM upgrade, $999; StarScript PostScript-compatible language board, $399; second letter-size paper cassette, $69; bottom letter-size paper cassette, $195; legal-size paper cassette, $85; executive-size paper cassette, $79; envelope cassette, $109.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 9 x 25 x 14 inches.
Weight: 25 lbs.
Emulations: Epson FX, HP PCL 4.

Star Micronics LaserPrinter 4 StarScript
List Price: $1,995; 2MB RAM upgrade, $499; 4MB RAM upgrade, $999; second letter-size paper cassette, $69; bottom letter-size paper cassette, $195; legal-size paper cassette, $85; executive-size paper cassette, $79; envelope cassette, $109.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 9 x 25 x 14 inches.
Weight: 25 lbs.
Emulations: Epson FX, HP PCL 4, Star Micronics StarScript PostScript interpreter.

CIRCLE 616 ON READER SERVICE CARD

TANDY CORP.

Tandy LP 950



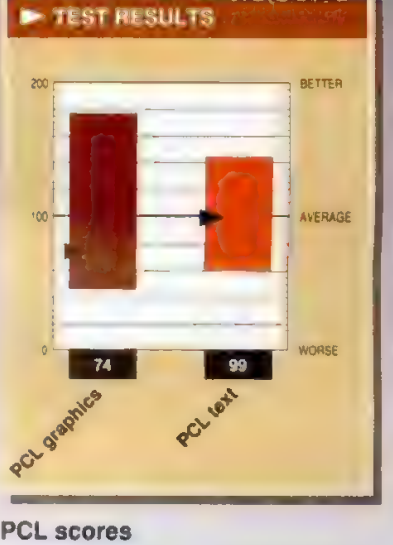
by John R. Quain

Under the assumption that it's always a good sign when a machine surpasses its rated specifications, we'd say the lights for Tandy Corp.'s sole laser offering, the $1,599 Tandy LP 950, are all green. Powered by a Sharp laser engine, the LP 950 beat its rated speed of 6 ppm by posting 6.2 ppm on PC Magazine Labs' tests. Though you will not find many discounts on its list price, the LP 950's small footprint, clear control panel, and 250-sheet cassette should attract those looking for a quick personal printer.

In its standard configuration, the LP 950 is the twin of the Dataproducts LZR 650 reviewed in last year's printer blockbuster (November 13, 1990). It is also virtually identical to the Sharp JX-9500, which is the 6-ppm version of the 9-ppm Sharp JX-9500H reviewed in this section.

The LP 950 comes with two standard fonts (Courier and Line Printer) and ac-

Tandy LP 950



PCL scores

In Short: Based on a 6-ppm Sharp engine and providing HP PCL 4, the $1,599 Tandy LP 950 is a respectable personal printer, though not the least expensive. One drawback is the lack of a PostScript option.

cepts HP soft-font cards in two available slots. In addition to HP PCL 4, it has Diablo, Epson FX, IBM Graphics Printer, and IBM Proprinter emulations. All those emulations may not be necessary, given

Tandy LP 950

the ubiquity of HP software drivers these days, but they're good to have if you run aground on any older programs. On the downside, Tandy loads the LP 950 with only 512K of memory. The company does offer a rather pricey $600 1.5MB memory upgrade card, and users who print graphics-intensive pages may find it necessary.

Standing 11 inches tall and equipped with a parallel and a serial port, the LP 950 is a squarish, vertically designed printer with a small 13- by 15-inch footprint for users with limited office space. Its eight-button membrane keypad with a 16-character LCD makes it easy to manage. Menu headings and choices are displayed on the LCD readout in plain English, enabling users to select the font, form length, symbol set, interface, emulation, and paper tray. A handy reset button will restore everything to the printer's HP PCL 4 defaults. Holding another button will print out a status page listing the life remaining on the 25,000-sheet developer and 50,000-sheet photoconductor cartridges ($150 for either one), so you needn't wait for printouts to become blurry and washed out before changing the cartridges.

Popping the top of the LP 950, however, exposes you to the inconveniences of its three-part photoconductor system. Installing all three parts, along with the roller cleaner and toner collection container, is fairly simple, but first-time users will find the instructions scant. Diagrams more precise are in order here. And no matter how adroit you may be, installing this three-part system means rolling up your sleeves to avoid the inevitable escape of black toner dust.

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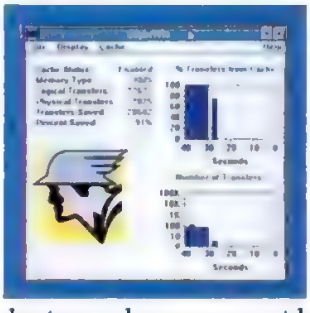

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Tucked neatly under the LP 950 is an enclosed letter-size paper tray with a capacity of 250 sheets. Just above it on the front is a manual-feed slot for transparencies and envelopes. When fed by hand, the LP 950 conveniently recognizes the input and automatically bypasses the lower tray. It will handle a paper-weight range of 16 to 34 pounds and a variety of sizes, from letter and legal to invoice, A4, and B5 paper sizes.

If you need more, an additional sheet feeder, which adds about 2.5 inches to the printer's height, is a $350 option. Unfortunately, the sheet feeder also requires another letter-size or legal-size paper cassette—another $70. An envelope feeder, which juts out about 10 inches from the front of the LP 950, will cost you another $350.

Close inspection of the Tandy LP 950's output revealed that curved edges were not as smooth as the HP LaserJet IIP's on downloaded fonts.

Performing beyond its rated 6 ppm, on PC Magazine Labs' tests the LP 950 managed a 6.2-ppm text speed—a little slower than the Sharp JX-9500PS. It handled the graphics speed test at 1.3 gppm, which is also a tad slower than the Sharp printer.

On the HP PCL torture test, the Tandy handled all the landscape and portrait maneuvers with aplomb. But close inspection revealed that some output was not as smooth as the HP LaserJet IIP on downloaded fonts, where normally curved edges took on a slightly jagged shape.

Tandy backs the LP 950 with a one-year warranty through its Radio Shack stores. Buyers will find the LP 950's $1,599 list price a little high in the current market. But Tandy's plans to offer other companies' wares in its new superstores may mean discounts on its own brands. If that happens, individual users should consider the LP 950 for its quick printouts and small real-estate demands. ■

FACT FILE

Tandy Corp., 1800 One Tandy Center, Fort Worth, TX 76102; 817-390-3011.
Tandy LP 950
List Price: $1,599; 1.5MB RAM upgrade, $600; paper-feed mechanism, $350; letter-size paper cassette, $70; legal-size paper cassette, $70; envelope cassette, $350.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 11 x 13 x 15 inches.
Weight: 33 lbs.
Emulations: Diablo, Epson FX, HP PCL 4, IBM Graphics Printer, IBM Proprinter.

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6. PC-MOS protects your investment in DOS. Because PC-MOS is DOS-compatible, most of your current DOS-based applications can be used in the PC-MOS environment, eliminating costs of new software and training.

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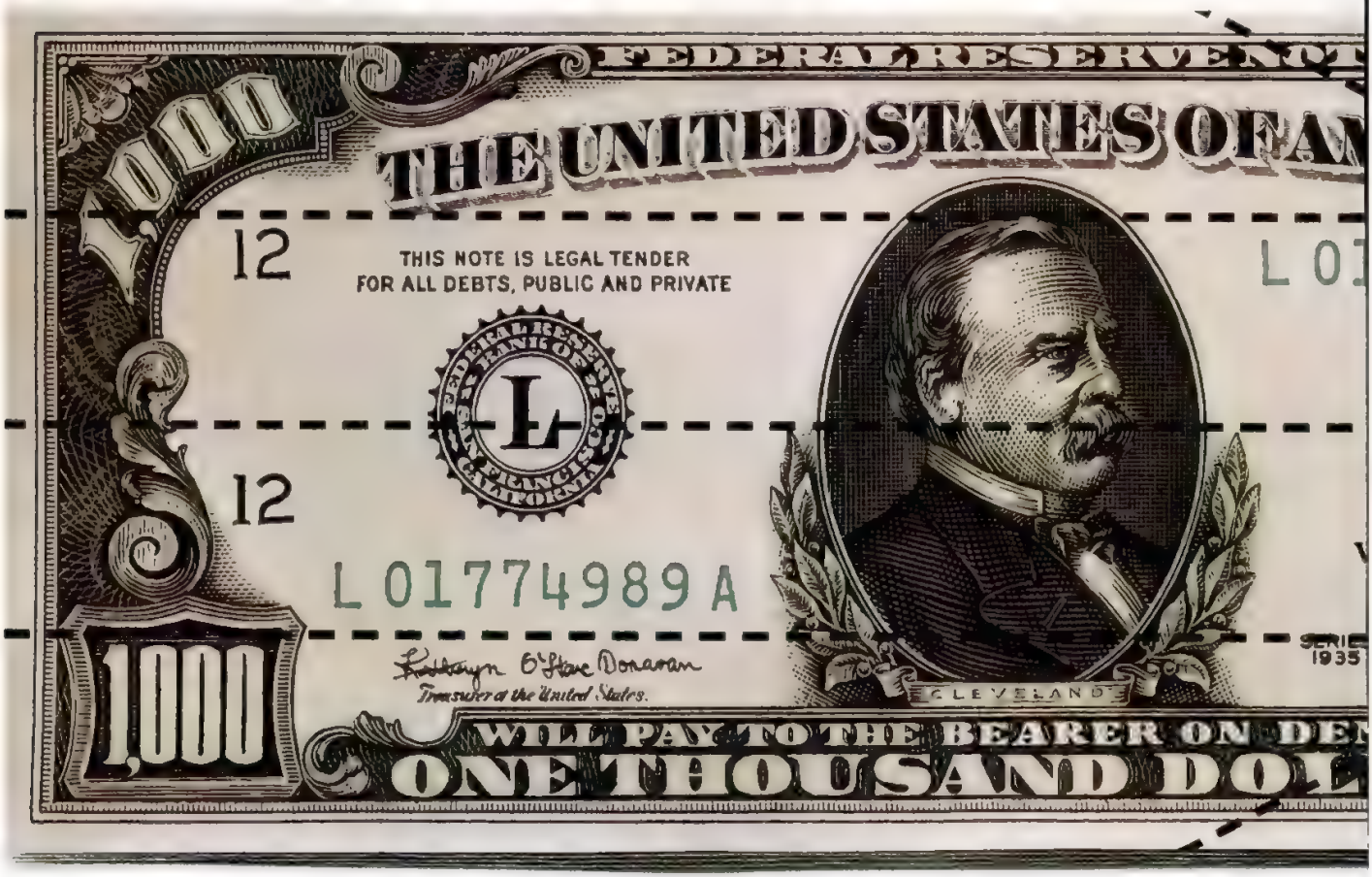
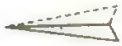


A. Fold bill in half lengthwise.

B. Fold back front corners.

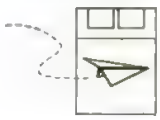
C. Make second fold on front corners.

D. Make a second lengthwise fold down.



E. Hold airplane up between thumb and forefinger.

F. Open a window. Toss.



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Shared Lasers

THE NEW BREED

by FRANK J. DERFLER, JR. AND STEVE RIGNEY

PHOTOGRAPHY: RICK BECKER

Designed for use on networks, these ten printers provide 10- to 24-page-per-minute output and large-paper capacities. Many have special features too costly to build into most single-user desktop laser printers: printing on both sides, multiple paper cassettes, and B-size output.

At a recent panel discussion on LANs, an audience member berated the panelists for advocating the installation of shared printers on networks. "You can find nice office printers with street prices ranging from $800 to $1,800, so why install expensive networks to share single printers?" he asked. Many people feel this

way, and having your own printer seems as natural as having your own desktop PC.

But there are practical, operational, and administrative reasons for sharing networked printers. Many people in an office don't generate enough print jobs to warrant dedicated use of a printer, even an $800 printer. Others don't want to worry about feeding paper and toner to a printer and taking care of its electromechanical foibles. When organizations use special forms, fonts, and devices like envelope feeders, it makes sense to make them available on a shared printer. The same holds for expensive special-purpose printers: B-size (11- by 17-inch) and color PostScript printers. Finally, shared printers are typically faster, in both rated speed and the speed with which a user gets back control of the PC. You don't have to wait for the PC to move the job slowly to a local printer before you can turn to other tasks.

for the fastest printing possible, a built-in network connection has a theoretical speed advantage.

MANY WAYS TO SHARE PRINTERS

A recent study of *PC Magazine* subscribers shows that 71 percent of the organizations our subscribers work for have connections between installed computers. And 51 percent use those connections to share peripherals such as printers. But there are many ways to share printers. In *PC Magazine*'s April 30, 1991, issue ("Building Workgroup Solutions: Buffered Printer-Sharing Devices"), we reviewed nine buffered printer-sharing devices that offer a practical and low-cost way to share several printers among many people without investing in LAN adapters and networking software. Zero-slot LANs like Artisoft's *LANtastic/Z* and Traveling Software's *DeskLink* allow a handful of users (sometimes just two) to access a printer, as well as share files and pass messages. But the typical way to share a printer is across a LAN using Ethernet, Token-Ring, or ARCnet adapters and cabling.

On a LAN, a networked PC acts as the print server. The print server accepts print jobs from the client computers, queues them according to specific criteria, and feeds them to an appropriate printer. Often, the print server software runs in the PC acting as a file server. This approach of putting the print and file service in the same PC is economical, particularly for networks that don't carry heavy file-access traffic or print jobs. But in congested networks, the task of handling the print jobs and communicating with the printers can slow down the access service provided by the file server. Also, because the printers' parallel-cable connection is typically limited to about 15 feet, you have to place the printers near the server and not the people who use them.

These two operational factors—file server slowdown and poorly located printers—lead to the use of separate PCs as print servers. While using a separate PC as a print server works well, it is rather costly and undermines the economics of shared printing.

SPECIAL-FUNCTION SERVERS

Earlier this year, several companies introduced products we call special-function servers, notably Intel PCEO's NetPort Print Server, Castelle's LANpress, and Hewlett-Packard Co.'s HP 33480A LAN connection (see "Special-Function Servers," January 15, 1991), which replace the parallel or serial connection between the print server and the printer with a LAN connection. (These devices are sometimes called special-purpose network servers, special-function print servers, or more generically, peripheral-sharing devices.) Although Apple Computer's LaserWriter line has had built-in AppleTalk networking capability for years, it took other companies (including Hewlett-Packard) until 1990 to introduce printers with their own Ethernet or Token-Ring connection capabilities.

When you use a printer with a built-in network connection, or when you use a special-function server to give a printer its own network connection, you still need a PC to act as a print server on the network. But the print server doesn't have to manage the tedious process of moving data to the printer through a parallel or serial port. Instead, the print server can quickly move jobs out over the network cabling so that the print server function steals less processing power from the print- and file-server PC, and the printer can be near the people who use it. When you optimize the LAN for printing, by using either a special-function server or an internal LAN attachment, the throughput bottleneck becomes the printer engine itself.

For the fastest printing possible, a built-in network connection has a theoretical speed advantage over a special-function server because the last foot or two of the entire connection—from your PC to the file server to the print server to the special-function server to the printer—is across a parallel (or worse, a serial) cable. An Ethernet or Token-Ring network is rated at 4, 10, or 16 megabits per second, while a serial connection is typically 9,600 bps, and a parallel connection falls somewhere in between. Eliminate the parallel or serial link with a built-in network connection and you may speed up delivery of finished pages, especially if you're printing charts or other graphics.

REVIEW CRITERIA

What exactly is a shared laser printer? As with the Supreme Court's definition of obscenity, it's hard to define but you know it when you see it. The most appropriate shared laser printers are faster, more flexible, and more costly than printers designed for individual use. Features such as multiple paper cassettes, large-capacity sheet feeders, devices to offset individual print jobs in the output tray, duplex printing, and sensors for the output tray are necessary in shared printers. Since you're sharing the cost of the printer among several users, you can probably also afford the highest possible output quality. We sought out laser printers with some or all of these attributes to include in this section. We also asked the manufacturers which of their printers they market as shared or network printers.

The ten printers in this review include the Eastman Kodak Ektaplus 7016 PS, the HP LaserJet IIISi, the IBM LaserPrinter 10L, the Kyocera F-5000A, the LaserMaster TrueTech 1200, the NCR 6436-0301, the Printware Pro-III, the QMS PS-2000, the Sharp JX-9700, and the TI microLaser XL PS35.

Because you can add effective network ports using devices like the Intel NetPort Print Server, we didn't require the printers to have the ability to house a built-in LAN adapter.

Eastman Kodak Ektaplus 7016 PS

16-ppm Kodak LED engine-based laser printer with Adobe PostScript, HP PCL 4, and the ability to double as a photocopier.

PCL TEXT SPEED	14.7 ppm
PS TEXT SPEED	14.5 ppm
ONE PAGE OUT	11.4 sec.
PCL GRAPHICS SPEED	2.4 gppm
PS GRAPHICS SPEED	0.5 gppm
PCL GRAPHICS TIME	0 min. 25 sec.
PS GRAPHICS TIME	1 min. 52 sec.

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HP LaserJet IIISi

17-ppm Canon engine-based laser printer with Adobe PostScript, HP PCL 5, and an AMD 29000 RISC processor.

PCL TEXT SPEED	14.6 ppm
PS TEXT SPEED	14.5 ppm
ONE PAGE OUT	14.9 sec.
PCL GRAPHICS SPEED	3.8 gppm
PS GRAPHICS SPEED	1.3 gppm
PCL GRAPHICS TIME	0 min. 15 sec.
PS GRAPHICS TIME	0 min. 45 sec.

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IBM LaserPrinter 10L

10-ppm IBM engine-based laser printer with HP PCL 4 and support for an optional $499 PostScript board with 600-dpi print capability.

PCL TEXT SPEED	8.9 ppm
ONE PAGE OUT	18.4 sec.
PCL GRAPHICS SPEED:	2.6 gppm
PCL GRAPHICS TIME	0 min. 23 sec.

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Kyocera F-5000A

12-ppm Kyocera LBP27 engine-based laser printer with HP PCL 4 and 11- by 17-inch paper handling.

PCL TEXT SPEED	13.6 ppm
ONE PAGE OUT	17.8 sec.
PCL GRAPHICS SPEED:	2.1 gppm
PCL GRAPHICS TIME	0 min. 28 sec.

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LaserMaster TrueTech 1200

20-ppm Hitachi Laserbeam 2000 engine-based laser printer with Microsoft TrueImage PostScript interpreter, a proprietary RISC processor, 11- by 17-inch paper handling, and 1,200- by 800-dpi printing.

PS TEXT SPEED	14.9 ppm
ONE PAGE OUT	7.4 sec.
PS GRAPHICS SPEED	1.3 gppm
PS GRAPHICS TIME	0 min. 45 sec.

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NCR 6436-0301

$7,995

15-ppm Ricoh 4150 engine-based laser printer with HP PCL 4 and a proprietary SCSI port.

PCL TEXT SPEED 12.4 ppm
ONE PAGE OUT 12.4 sec.
PCL GRAPHICS SPEED 2.3 gppm
PCL GRAPHICS TIME 0 min. 26 sec.

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Printware Pro-III

$17,990

12-ppm Copal SLB-6000 engine-based laser printer with Printware Printstyle PostScript interpreter and 1,200- by 600-dpi resolution.

PS TEXT SPEED 8.5 ppm
ONE PAGE OUT 13.8 sec.
PS GRAPHICS SPEED 0.6 gppm
PS GRAPHICS TIME 1 min. 43 sec.

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QMS PS-2000

$15,995

20-ppm Ricoh engine-based laser with Adobe PostScript, HP PCL 4, 11- by 17-inch paper, and a RISC processor.

PCL TEXT SPEED: 17.2 ppm
PS TEXT SPEED. 17.1 ppm
ONE PAGE OUT 13.3 sec.
PCL GRAPHICS SPEED 2.9 gppm
PS GRAPHICS SPEED 1.6 gppm
PCL GRAPHICS TIME 0 min. 20 sec.
PS GRAPHICS TIME 0 min. 38 sec.

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Sharp JX-9700

$3,395

16-ppm Sharp JX-97 engine-based laser with HP PCL 4.

PCL TEXT SPEED 14.4 ppm
ONE PAGE OUT 9.8 sec.
PCL GRAPHICS SPEED: 2.1 gppm
PCL GRAPHICS TIME 0 min. 29 sec.

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TI microLaser XL PS35

$3,149

16-ppm Sharp JX-97 engine-based laser printer with Adobe PostScript and HP PCL 4.

PCL TEXT SPEED 14.7 ppm
PS TEXT SPEED 14.6 ppm
ONE PAGE OUT 10.4 sec.
PCL GRAPHICS SPEED 2.6 gppm
PS GRAPHICS SPEED: 0.6 gppm
PCL GRAPHICS TIME 0 min. 23 sec.
PS GRAPHICS TIME 1 min. 39 sec.

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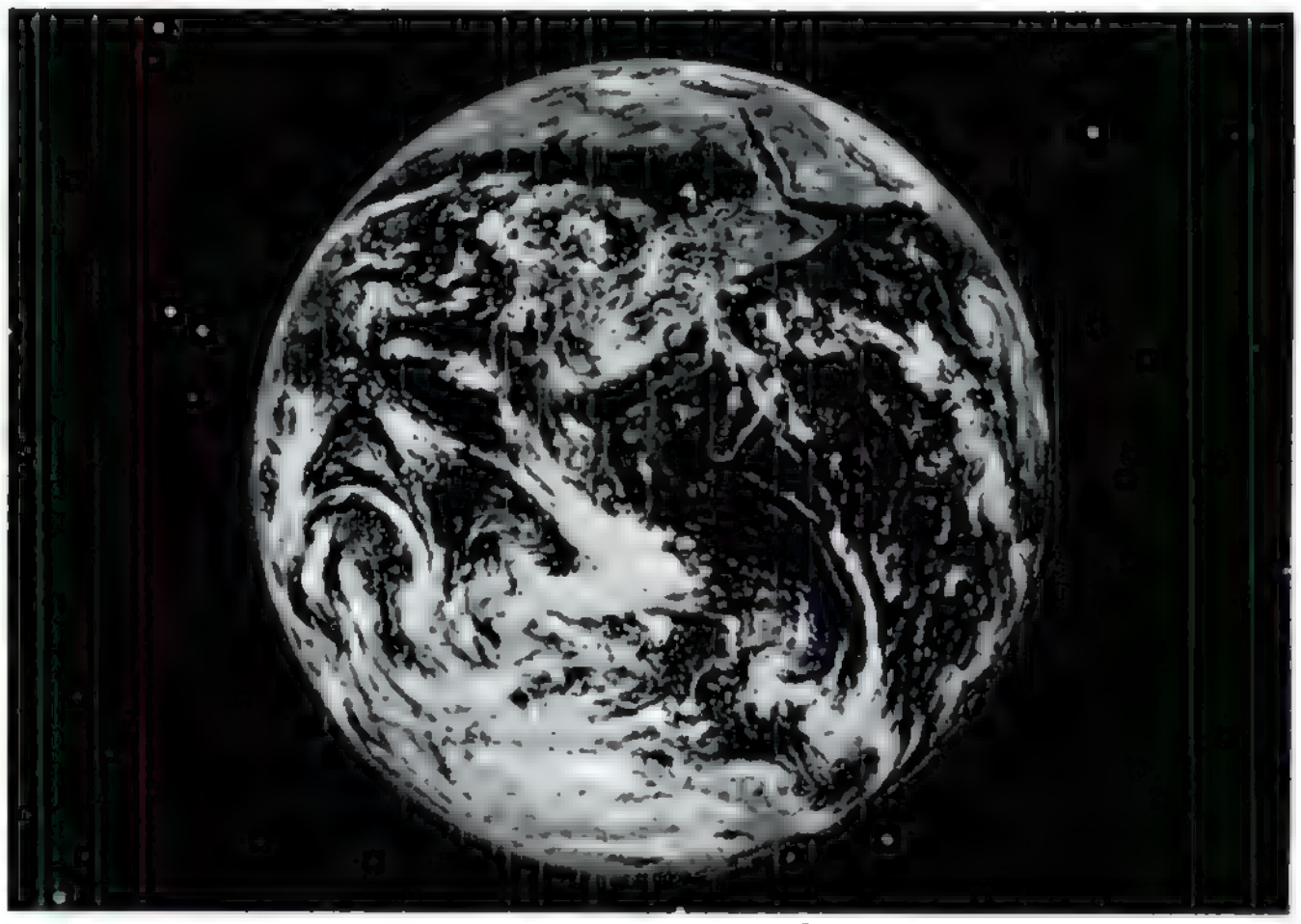
—***David Hess,*** *Executive Director, Environmental Resources and Energy Committee, Pennsylvania Senate*



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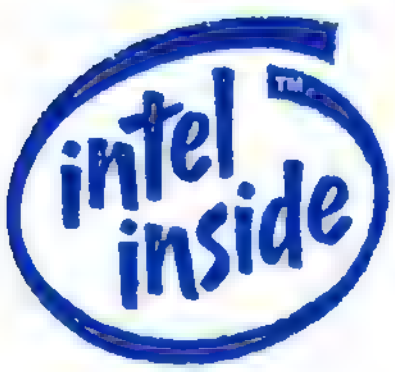

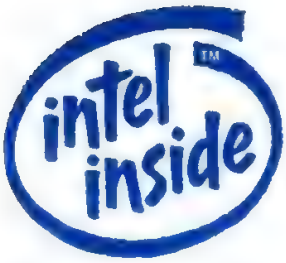

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CIRCLE 176 ON READER SERVICE CARD

Since the speed of the printer engine can be a performance bottleneck in shared printing, we recommend printers with a throughput of 12 to 15 pages per minute or higher, with one exception: The ten reviewed printers are rated at 12 to 24 ppm. We brought the 10-ppm IBM LaserPrinter 10L into this review because of its other shared-printer features and its low price. You could conceivably afford to attach two LaserPrinter 10Ls to the LAN for the price of another product with many similar features.

Another factor in producing pages quickly is the printer's processor. To help compose imaged pages as quickly as possible, three of these printers—the HP LaserJet IIISi, the LaserMaster TrueTech 1200, and the QMS PS-2000—have RISC processors that pack as much power or more than the processor in your PC.

Some of the shared lasers in this review are large in terms of size (with an average weight of 99 pounds), price, and capabilities. But whether you want a production printer or simply one for infrequent users to share, you can find good alternatives in this lineup of shared printers.

EASTMAN KODAK CO.

Eastman Kodak Ektaplus 7016 PS

by John R. Quain

The $5,795 Eastman Kodak Ektaplus 7016 PS is a two-headed monster. Similar to the imminent four-function *Hydra* products that will combine a fax, scanner, copier, and printer in one, the Ektaplus 7016 PS is a combination of the last two features: This machine prints 8.5- by 11-inch copies at 6 pages per minute and prints out text at a rated 16 ppm.

If being one up on other shared laser printers isn't enough for you, the Ektaplus 7016 PS also supports six printer emulations: Adobe PostScript, Diablo, Epson FX, HPGL, HP PCL 4, and IBM Proprinter. Most important for laser sharing, the Ektaplus 7016 can manage four different inputs simultaneously.

The Ektaplus 7016 PS is the PostScript version of Kodak's $4,495 Ektaplus 7016 (discussed in the sidebar "Kodak Ektaplus 7016: A Multifunction Solution for Multiuser Printing," May 28, 1991, and First Looks, March 26, 1991). The Ektaplus 7016, which includes the same features as the Ektaplus 7016 PS, can be upgraded to PostScript for $1,995 (including 4MB of additional memory). But that means that making the PostScript upgrade decision later will cost you an additional $700.

COPIER AND LASER PRINTER

In its standard configuration, the Ektaplus 7016 PS comes with a Centronics parallel port, an RS232C serial interface, and room for two more ports. Different settings can be stored for each port, and because all of the ports are active simultaneously, it enables both PC and Macintosh users (using the $195 AppleTalk option) to access the printer without leaving their desks. The Ektaplus 7016 PS automatically queues incoming print jobs, and printing can be interrupted at any time to make copies. When the copying is complete, you just put the printer back on-line. If you forget to reactivate printing when you're done, the printer will return to the interrupted print job after 60 seconds of inactivity.

Designed for small businesses and company departments, the Ektaplus 7016 PS's 16- by 38- by 21-inch bulk means it requires a desk of its own. In fact, it looks more like a copier than a printer. Fortunately, its straight-through paper path doesn't jam like an office copier. And while the control panel is less cluttered than most of today's copiers and printers, the Ektaplus 7016 PS's 40-character LCD panel allows for adjustment of all the most commonly used functions.

Inside, the Ektaplus 7016 PS's 15,000-sheet-per-month duty cycle relies on a Kodak LED-array print engine, and the printer couples that with an optical copying system (rather than scanning and digitizing the image) to take advantage of its photoconductor belt.

Inexperienced users, however, will find the initial setup a labyrinth of parts and consumables. A videotape and step-by-step diagrams in the owner's manual help users with toner installation, but there are still a lot of components to juggle, including a fuser wick, a multiple-wire primary charger, a sensitive photoconductor belt, a cleaning station, and a transfer charger. A successful installation rewards your efforts by automatically kicking out a status page of all the Ektaplus 7016 PS's current settings.

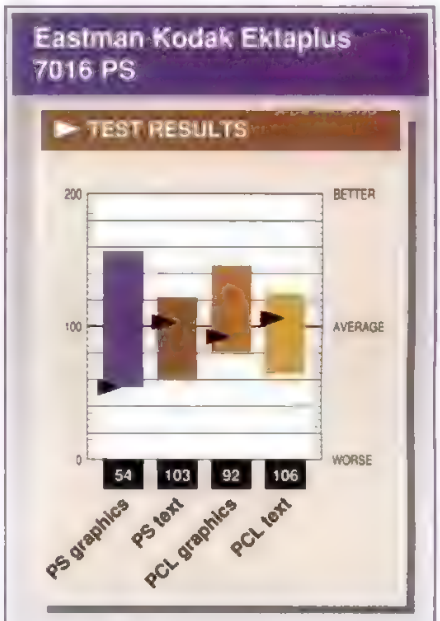
PERFORMANCE ISSUES

Although the Ektaplus 7016 PS delivers excellent PostScript graphics, its performance on PC Magazine Labs'

• Eastman Kodak Ektaplus 7016 PS

graphics speed test was a bit slow: 0.5 graphics pages per minute using a 300-dot-per-inch LaserWriter driver. On the other hand, its PostScript text ran at 14.5 ppm, just a shade off its top HP PCL text speed of 14.7 ppm.

The only difficulty the Ektaplus 7016 PS faced was on PC Labs' HP PCL 4 torture test, where it skipped to the end of the print job after encountering three-



Shared laser scores

In Short: The 16-ppm $5,795 Eastman Kodak Ektaplus 7016 PS can manage four ports at once, supports Adobe PostScript and HP PCL 4, has a 500-sheet paper capacity, and makes 8.5- by 11-inch copies. Although it provides adequate printer sharing, the Ektaplus 7016's photocopier functionality is limited and its complex replaceable component system may frighten away some users.

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9650V32	INT	–	✓	19,200	–	$599
2400V42	EXT	✓	✓	9600	–	$249
2400MNP	EXT	–	✓	4800	–	$229
2450MNP'	INT	–	✓	4800	–	$189
MB2400EX	EXT	–	opt.	4800	–	$199
MB2450'	INT	–	✓	4800	–	$159
MB2296SR	INT	–	✓	4800	9600	$199
MB2296F	INT	–	✓	4800	9600	$179

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CIRCLE 319 ON READER SERVICE CARD

EDITORS'CHOICE

- HP LaserJet IIISi
- QMS PS-2000

Instead of installing numerous cheap page printers, some businesses find that one expensive, capable printer represents a better price bargain and a performance boost.

THE WINNERS: QMS AND HP

By far the fastest and most feature-rich shared laser printer is the 20-page-per-minute $15,995 QMS PS-2000. Running at the highest speeds of any page printer reviewed this year (roughly 17 ppm on PC Magazine Labs' tests in both its Adobe PostScript and HP PCL 4 modes), the PS-2000 offers B-size (11- by 17-inch) printing ability, a standard 500-sheet paper capacity, an auto-sensing feature, which is the ability to switch automatically between PostScript and PCL emulation, and an 8MB buffer (expandable to 16MB) as standard features. The PS-2000 also contains other standard features aimed specifically at high-end LAN operation, including the ability to assign different paper cassettes to specific print jobs and an anti-jamming feature that will automatically reprint a jammed page and pick up where the job left off. Options for the PS-2000 include a $3,495 high-capacity upgrade to 1,500 sheets with duplexing, a $1,995 direct Ethernet adapter, and a $1,995 DECnet emulation option. There is no direct Token-Ring connection available for this machine, though AppleTalk is standard. If your needs include B-size printing, this is really the printer to buy.

The 17-ppm $5,495 HP LaserJet IIISi also wins an Editors' Choice because it's a superior shared laser at little more than one-third the price of the PS-2000. Providing crisp dark output with its Resolution Enhancement Technology, Hewlett-Packard's LaserJet IIISi performed admirably on our PCL speed tests (15 ppm in text mode, while its PCL graphics speed was the fastest of any laser this year, at almost 4 gppm) using its PCL 5 emulation.

There is a dealer-installable 35-font Adobe PostScript upgrade ($895), though you'll also need 2MB to 4MB extra, for a total cost between $1,100 and $1,400. With the PostScript option installed, the LaserJet IIISi doesn't support auto-sensing, only a software switch between PCL and PostScript. Extended Systems of Boise, Idaho (800-235-7576), however, offers the $595 BridgePort ESI 2674, which gives LaserJet IIISi users PCL-to-PostScript auto-sensing, as well as AppleTalk, parallel, and RJ-45 ports.

The LaserJet IIISi also offers other shared features and options, including a $695 user-installable duplexing module, two 500-sheet input cassettes (which will take over for each other if one runs out), and an $895 Token-Ring adapter or a $695 Ethernet connection. If you don't need B-size printing but do need a fast, competent, and cost-efficient shared laser, the LaserJet IIISi is the unquestionable choice.

NICE PRICES, SCANTY FEATURES

An honorable mention goes to the $3,149 TI microLaser XL PS35. This small-footprint machine uses the Sharp JX-97 engine (used in the Sharp JX-9700, also reviewed in this issue), but provides slightly faster performance than the JX-9700 (the TI managed almost 15 ppm on PC Labs PCL and PostScript text speed tests) and more features, such as Adobe PostScript, for less money (the Sharp JX-9700 lists for $3,395). The microLaser doesn't win Editors' Choice because it doesn't offer enough sharing features (such as simultaneous multiuser communications, auto-sensing, and direct Ethernet or Token-Ring network adapters) to make it a viable network printer. From a desktop laser printer perspective, this TI product is an excellent machine; but from a multiuser angle, TI should be concentrating less on low prices and more on including the features necessary for this market niche.

Of the other shared lasers, the $7,995 NCR 6436-0301 attempted to enhance its multiuser status with the addition of a SCSI port; since this SCSI connection is available only in conjunction with NCR's most current line of System 3000 PCs, it limits the printer's usefulness. The $14,995 20-ppm LaserMaster TrueTech 1200 offers beautiful 1,200- by 800-dpi Microsoft TrueImage PostScript output but uses only a video interface and offers no other connection options. The $7,995 Kyocera F-5000A is a fairly full-functioning network machine that offers multiuser communications and B-size printing among other features, but our review unit suffered from weak output quality and problems interpreting gray scales in PCL 4 emulation mode. The $5,795 Eastman Kodak Ektaplus 7016 PS is a novel combination of laser printer and photocopier, but this design raises the unit's price and limits each function so that buying one of each would be more useful and frugal in the long run.

Of course, some may argue that simultaneous multiuser communications and direct network adapters are simply unnecessary, given the existence of advanced printer-sharing devices such as Intel's $695 NetPort (503-629-7000) or Microtest's $495 to $695 LANPort (800-526-9675). While these printer-sharing products perform their promised connections admirably, they do add extra cost to a printer with a function it could handle internally; a direct connection may be significantly faster.

level nested macros. Eastman Kodak Co. has developed ROMs that solve this problem but couldn't tell us when they'd be available. This is not, however, a problem that will give you trouble when you are running typical applications.

Outside of this difficulty, the Ektaplus 7016 PS turned out PCL 4 graphics at a respectable 2.4 gppm on PC Labs' tests and yielded smooth curves. Compared with the HP LaserJet IIISi's output, the Ektaplus 7016 PS's gray shades looked washed out (a result of its "write white" technology, which causes the electrical charge to be removed from white areas of the film, leaving the negatively charged areas to attract positively charged toner particles and to print as black). A simple adjustment using the Ektaplus 7016 PS's control panel, however, increases the print density for darker blacks.

To the standard HP LaserJet Series II resident fonts, Courier and Line Printer, Eastman Kodak adds Helvetica and Roman typefaces, and there are also 35 scalable PostScript fonts already on-board. The unit can accept downloadable fonts, but a resident slashed zero is not available. This fall, Eastman Kodak expects to address the popularity of Microsoft's GUI interface by introducing a special driver for *Microsoft Windows*, 3.0.

The Ektaplus 7016 PS will not handle duplexing duties, but it is capable of automatically switching from one cassette to the other. It can be set to deliver the printouts in a face-up or face-down orientation. A side-mounted envelope slot eliminates the need to remove a paper cassette for manual printing. Individual letterhead stock can also be fed by hand over the top of the cassettes.

To increase customer support, Eastman Kodak has extended its original 90-day parts-and-labor warranty on the Ektaplus 7016 PS to one year with on-site service and a toll-free technical support line. Prices on the Ektaplus 7016 PS—sold only through dealers—should run 20 percent or more below list price, placing it within striking distance of other shared laser printers that don't offer the advantage of simultaneously active ports or a copier. With an estimated cost per page of 3 cents, it's a little more costly to operate than some of the shared laser printers in this roundup, but considering the Eastman Kodak Ektaplus 7016 PS's advantages, many businesses will agree that two heads are better than one.

FACT FILE

Eastman Kodak Co., Printer Products Division, 901 Elmgrove Rd., Rochester, NY 14653; 800-344-0006.

Eastman Kodak Ektaplus 7016 PS

List Price: $5,795; 1MB RAM upgrade, $250; 2MB RAM upgrade, $500; additional font cards, $150 to $250; A4-size paper cassette, $75; additional letter-size paper cassette, $75; additional legal-size paper cassette, $80; additional output tray, $50; additional parallel and serial ports, $95 each; AppleTalk interface, $195.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 16 x 38 x 21 inches.

Weight: 85 lbs.

Emulations: Adobe PostScript, Diablo, Epson FX, HPGL, HP PCL 4, IBM Proprinter.

CIRCLE 618 ON READER SERVICE CARD

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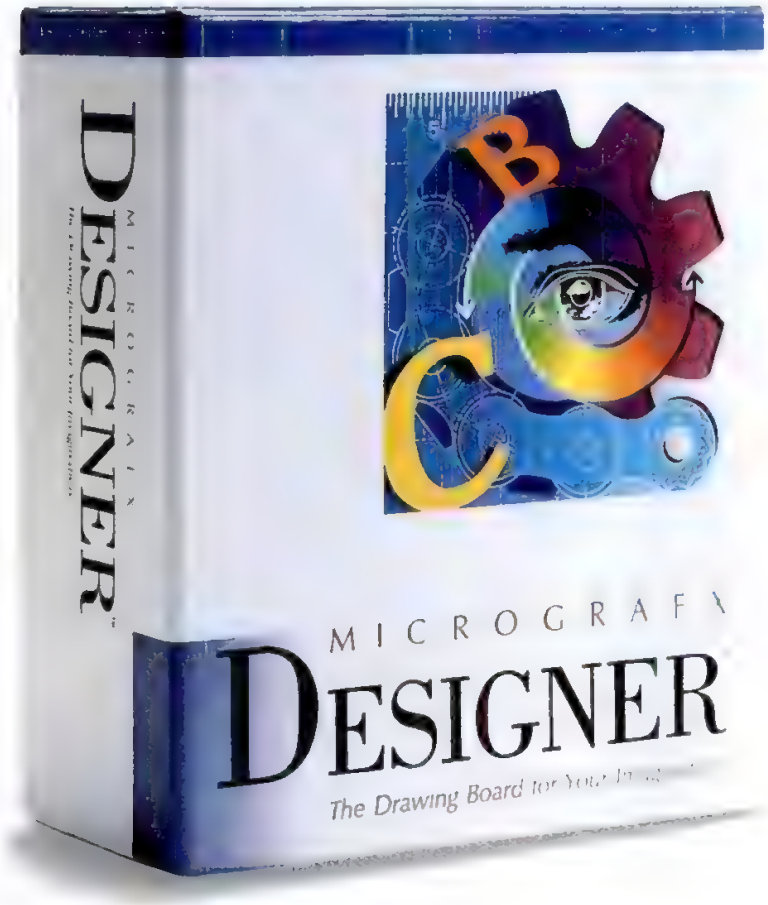

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Features	Designer	Corel Draw
Drawing layers	64	1
Dimensioning	Yes	No
Object snap	Yes	No
Maximum drawing size	132″ × 132″	17″ × 17″
Edit in full color	Yes	No
Clip art images	Over 1,700	750
Named symbols	Yes	No
PageMaker 4.0 filter	Yes	No
On line help screens	Yes	No
24 hour support	Yes	No

> **The experts' verdict: "No contest."**
> *Software Digest* gave Designer five stars to Corel's three, concluding: ***"Designer provides the best overall free-form graphics package. It offers state-of-the-art features, good performance, and unmatched ease of learning and use in a sophisticated package."***

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Designer system requirements: 286 (386 recommended) IBM PC or compatible, or PS/2. 1 MB RAM (2 MB RAM recommended). 20 MB (or larger) hard disk. Windows 3.0. DOS 3.1 (or higher). Mouse or digitizing pad. Windows-compatible monitor.

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$20,000
Total benefits
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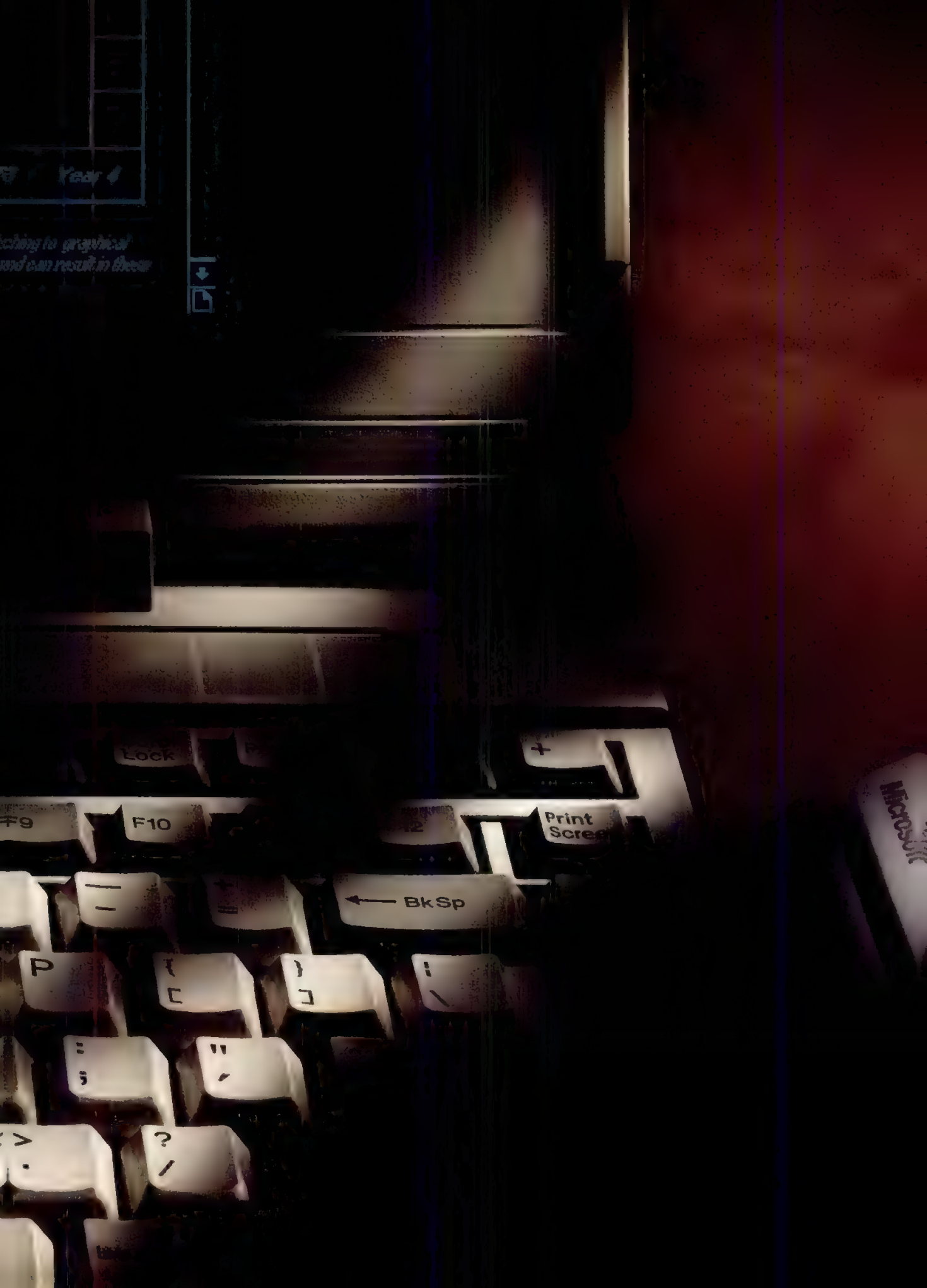
$1,670,625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CIRCLE 158 ON READER SERVICE CARD

PERFORMANCE TESTS: SHARED LASER PRINTERS

PC LABS

The QMS PS-2000 is the undisputed king of shared laser printer performance. But the Eastman Kodak Ektaplus 7016 PS and the TI microLaser XL PS35 tied for second place in HP PCL text mode, while the LaserMaster TrueTech 1200 took second in PostScript, and the HP LaserJet IIISi won the PCL graphics competition.

WHAT THE NUMBERS MEAN

The shared laser printer category is comprised of high-end, high-speed devices (rated between 10 and 20 pages per minute) designed for network use—sometimes as **network nodes**, or more frequently **in a network printer/print server** combination. We tested all of these printers in the latter combination using PostScript interpreters, HP PCL, or both if supported.

THE LEADERS

The QMS PS-2000 is the fastest shared laser printer in Adobe PostScript and HP PCL 4 modes. It beat the competition on all tests except the HP PCL graphics speed test, where it placed second after the HP LaserJet IIISi. In PostScript graphics mode, the PS-2000 produced output at a rate of 1.6 graphics pages per minute, and it ran through our PostScript and HP PCL text tests at 17.1 ppm and 17.2 ppm, respectively. The PS-2000's use of a 20-ppm Ricoh M3 engine equipped with 8MB of RAM and a 25-MHz MIPS R3000 RISC processor may help to explain these speeds; this is definitely a high-end printer.

Supporting PCL 5 and Adobe PostScript, the LaserJet IIISi is also an impressive printer in both text (14.5 ppm) and graphics (1.3 gppm) modes. In addition, the LaserJet IIISi is the fastest PCL graphics printer we saw this year, producing our graphics image at a remarkable 3.8 gppm. The LaserMaster TrueTech 1200, a Microsoft TrueImage PostScript printer, claimed a 20-ppm engine speed and produced 1.3 gppm on our graphics speed test and 14.9 ppm on our text speed test, falling just behind the QMS model.

ANOMALIES AND PROBLEMS

Both the Sharp JX-9700 and the TI microLaser use the 16-ppm Sharp JX-97 engine, yet because the TI microLaser uses a proprietary controller, it managed to squeeze an extra 0.5 gppm in PCL graphics mode and 0.3 ppm in PCL text mode. The TI microLaser also provides Adobe PostScript, which produced our graphics image at the second-slowest rate, 0.6 gppm; however, its PostScript text rate is a speedy 14.6 ppm.

The Eastman Kodak Ektaplus 7016 PS with Adobe PostScript is the slowest PostScript graphics printer, at a rate of 0.5 gppm, but it truly excels in both PostScript and PCL text modes with speeds of 14.5 ppm and 14.7 ppm, respectively. However, the Ektaplus 7016 PS had some difficulty with our PCL 4 torture test; it was unable to print our three-level nested macros. Few applications make use of this PCL 4 feature, though, so the deficiency shouldn't be a problem in normal use. Eastman Kodak Co. has solved the problem with new ROMs but would not say when the solution will be available.

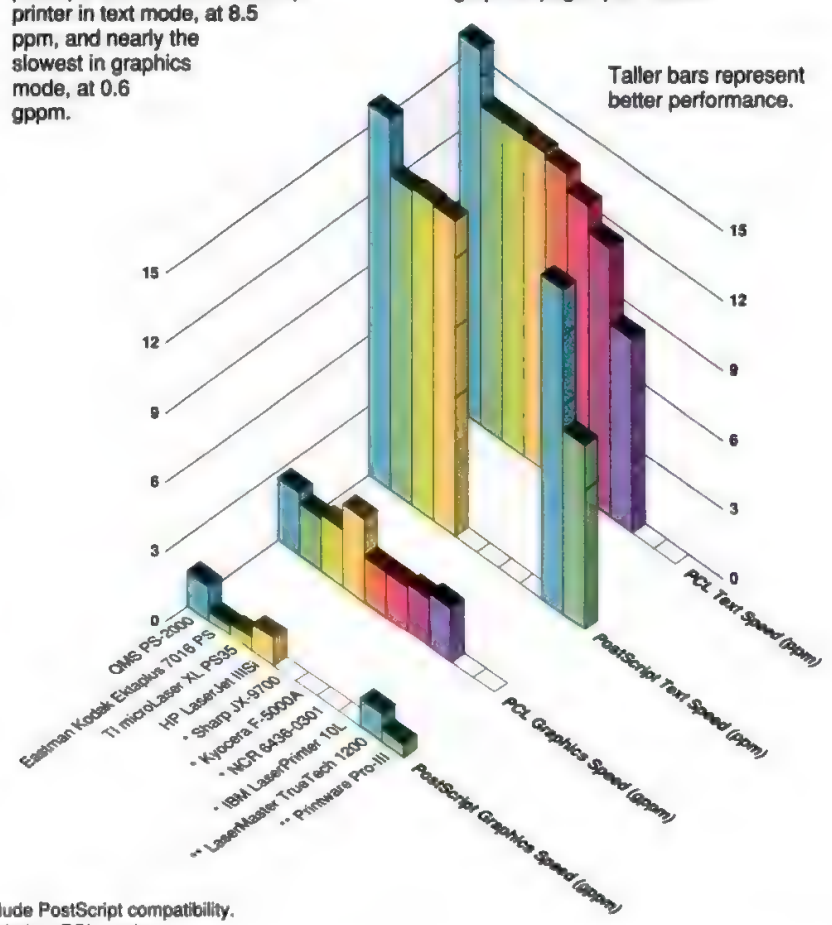
THE REST OF THE FIELD

Both the Kyocera F-5000A, at 2.1 gppm in PCL graphics mode and 13.6 ppm in PCL text mode, and the NCR 6436-0301, at 2.3 gppm in PCL graphics mode and 12.4 ppm in PCL text mode, are solid performers. The F-5000A ran faster than its 12-ppm rated proprietary engine, largely due to its Motorola 68020 processor chip. Meanwhile, the massive Printware Pro-III (at 1,200 by 600 dots per inch using the Printware Printstyle PostScript interpreter) is the slowest PostScript printer in text mode, at 8.5 ppm, and nearly the slowest in graphics mode, at 0.6 gppm.

Printware attributes the slow speed to its Copal SLB-6000 engine, which is rated at 12 ppm in landscape mode only, not at portrait mode, where it is rated at 9 ppm. The IBM LaserPrinter 10L with a rated 10-ppm proprietary engine turned in the slowest PCL text speed time, 8.9 ppm, but ran at a respectable 2.6 gppm in PCL graphics mode.

The **Text Speed** test measures the time it takes to send and print ten copies of a two-page business letter with 1-inch margins in 10-character-per-inch type. Results are reported in pages per minute.

The **Graphics Speed** test measures the time it takes to send and print two copies of a graphics image created with *PageMaker* and *Microsoft Windows*. Results are reported in graphics pages per minute.



* The tested configuration of this printer does not include PostScript compatibility.
** The tested configuration of this printer does not include a PCL mode.

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CIRCLE 233 ON READER SERVICE CARD

HEWLETT-PACKARD CO.

HP LaserJet IIISi

by Bill O'Brien

The $5,495 HP LaserJet IIISi is certainly a solid step for Hewlett-Packard Co. into the high-end laser arena. And with the benefit of numerous enhancements and tweaks, it's truly the king of the LaserJets.

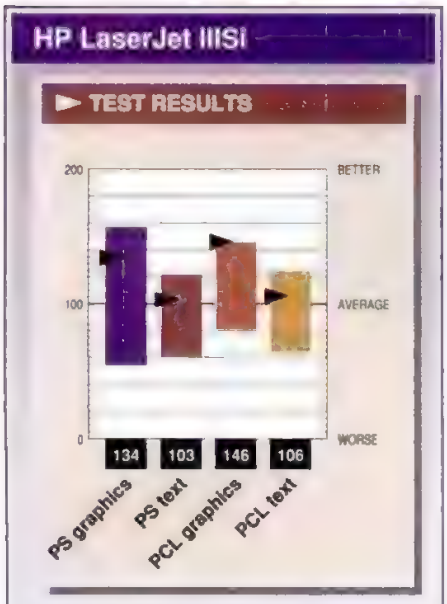
The LaserJet IIISi is built on the Canon engine—as are all LaserJets—but the control comes from an AMD 29000 reduced instruction set (RISC) processor. Both HPGL and HP PCL 5 emulations are packed into the controller, and 1MB of RAM (expandable to 17MB) is standard.

The LaserJet IIISi comes with dual 8.5- by 11-inch paper cassettes, each with a 500-sheet capacity. The output tray will hold 500 sheets and has a jogger to separate print jobs. There's even a $695 user-installable duplex printing option, and carrying on the tradition that started with the LaserJet III and IIID, the LaserJet IIISi includes two very important features: HP PCL 5 support and Resolution Enhancement Technology (RET).

HP PCL 5

HP PCL 5 (used by the entire LaserJet III family) supports scalable fonts. There are 14 bitmapped fixed-pitch fonts included with the printer, but there are also 13 additional proportionally spaced scalable fonts included. Using Intellifont technology (developed by Agfa Compugraphic and available at no charge from HP; call 303-353-7650), the fonts can be scaled from 0.25 points high to nearly 14 inches.

Font freaks can also take heart from HP's Adobe PostScript option, which adds 35 Adobe fonts to the LaserJet IIISi. No longer restricted to cartridge form, Adobe PostScript is available in a special version of the LaserJet IIISi that also includes



Shared laser scores

In Short: The fairly competitive $5,495 price tag of the HP LaserJet IIISi will get you font scaling, HP PCL 5, a 17-ppm rating, and on-site service. Even the $6,595 Adobe PostScript version is well within reason, and the entire package will make an excellent addition to your network.

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CIRCLE 476 ON READER SERVICE CARD

intel inside

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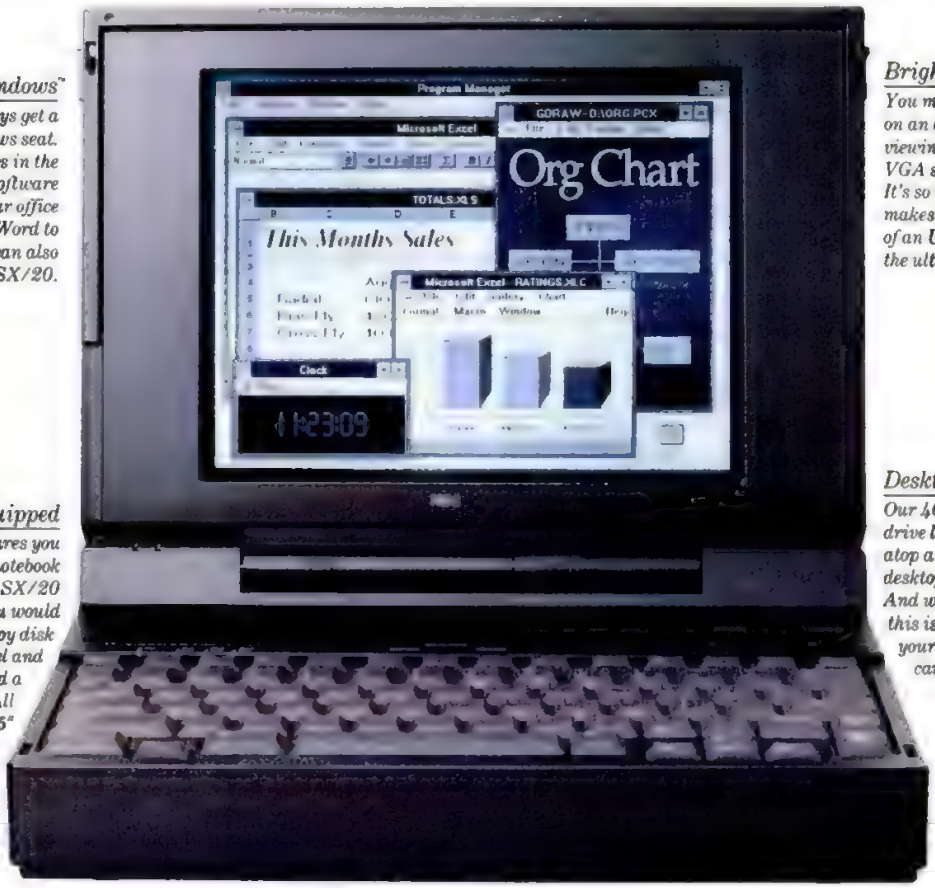

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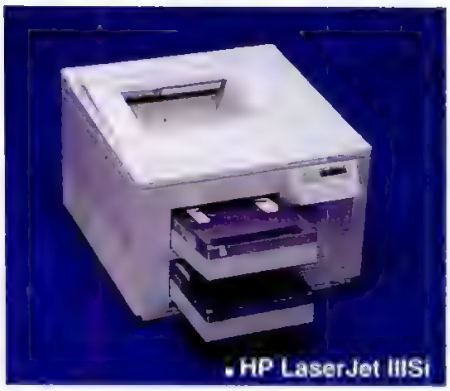
CIRCLE 730 ON READER SERVICE CARD


HP LaserJet IIISi

2MB of memory and sells for $6,595. The PostScript option alone is available as an $895 upgrade to the standard LaserJet IIISi, but you'll also need a $139 1MB memory upgrade to make it work. (The LaserJet IIISi is user-expandable from its basic 1MB configuration to 17MB with low-cost 1MB or 4MB SIMMs.)

And then there is Resolution Enhancement Technology. Invented by HP and employed in its LaserJet III printer family, RET has been imitated by other vendors as well. It is HP's method of extending the perceived resolution of the output without going through the expense of actually using a higher-resolution print engine. At 300 dots per inch, most printers have the same basic dot size and can only place each dot in one specific place within the 90,000 possible positions per printed square inch. RET provides for a variable-size dot (using a toner rated at 8,000 copies) as well as variable horizontal alignment of its print position. The effect on text and line art (greatly reduced jagged edges in particular) is outstanding.

> *the effect of RET on text and line art (greatly reduced jagged edges in particular) is outstanding.*

RISC-based machines are known for their speed, and the LaserJet IIISi is no exception, with its rated 17 pages per minute. PC Magazine Labs' speed tests clocked the LaserJet IIISi at 14.6 ppm for text and an impressive 3.8 graphics pages per minute under its PCL 5 emulation (the fastest PCL graphics of any shared laser printer that we tested). Its Adobe PostScript emulation yielded 14.5 ppm in text mode and 1.3 gppm on graphics. These results were culled with the printer connected to a server through its parallel port.

HP offers Ethernet ($695) and Token-Ring ($895) interface options that are compatible with both Novell and 3Com environments.

But with all of the new printer technology, there are some compatibility issues. Most important are those concerning existing emulation cartridges. In most if not all cases, emulation cartridges will not work with the LaserJet IIISi. And because the LaserJet IIISi uses SIMMs for mem-

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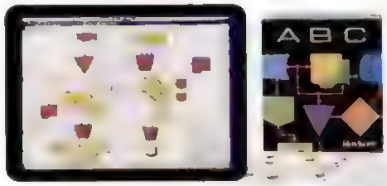

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CIRCLE 124 ON READER SERVICE CARD

the LaserJet IIISi reaffirms HP's position as a laser-printing standard.

ory expansion, older LaserJet memory expansion boards are incompatible. HP warns that JetScript and printer-sharing devices that use the video I/O port are not compatible either.

HP's warranty on the LaserJet IIISi is for one year on parts and labor, including on-site service from your dealer or from HP directly. Considering that the only specified routine maintenance is the replacement of the fuser assembly after 200,000 copies, this coverage should prove adequate.

The HP LaserJet IIISi reaffirms HP's position as a laser-printing standard. With a competitive price tag, PCL 5, respectable speed, typically excellent HP print quality, high paper capacity, multiple-interface support, direct network connection, and Adobe PostScript (whew!), it trumpets HP's arrival on the shared laser scene.

FACT FILE

Hewlett-Packard Co., 19310 Pruneridge Ave., Cupertino, CA 95014; 800-752-0900.

EDITORS' CHOICE

HP LaserJet IIISi

List Price: $5,495; with 2MB RAM upgrade and Adobe PostScript, $6,595; 1MB SIMM upgrade, $169; 4MB SIMM upgrade, $499; Adobe PostScript upgrade, $895; duplex printing option, $695; legal-size paper cassette, $129; executive-size paper cassette, $129; A4-size paper cassette, $129; envelope cassette, $495; Ethernet expansion interface, $695; Token-Ring expansion interface, $895.

Standard Warranty: One year on parts and labor, with on-site service from HP or an authorized dealer.

Dimensions (HWD): 17 x 22 x 24 inches.

Weight: 106 lbs.

Emulations: HPGL, HP PCL 5.

CIRCLE 619 ON READER SERVICE CARD

IBM CORP./LEXMARK

IBM LaserPrinter 10L

by Bill O'Brien

IBM Corp./Lexmark's $2,995 IBM LaserPrinter 10L takes IBM's 10-page-per-minute IBM LaserPrinter 10 and increases the paper capacity to 700 sheets, adds an output paper jogger, increases the output-tray capacity to 250 sheets, and adds a tray-full sensor. This gives you a solid network printer, but a fairly slow one compared with the competition. IBM solves this speed dilemma in a unique manner: It wants you to buy two.

A GREAT VALUE?

On the surface the LaserPrinter 10L's $2,995 list price is excellent, but it is, of course, only the base price. Even so, the list of standard features is far from bottom-of-the-line. The LaserPrinter 10L comes with 1MB of memory and is expandable to a maximum of 9MB using a proprietary SIMM-style design. Standard emulations include HPGL, HP PCL 4, and IBM's Personal Printer Data Stream (PPDS) mode, compatible with the Proprinter XL graphics printer.

IBM LaserPrinter 10L

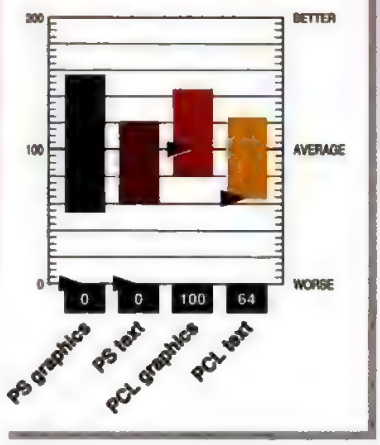
There's no shortage of fonts, either. You'll find 12 bitmapped fonts in HP PCL 4 and 10 bitmapped fonts in PPDS. There are also 16 scalable Adobe PostScript fonts included in PPDS, and in the box you'll find a disk with 17 scalable screen fonts. If that's not enough, you'll find two font cartridge slots for any of IBM's credit-card-size font cartridges.

Underneath all of the options is the IBM proprietary laser engine used by all of IBM's LaserPrinters. The engine is a blank slate as far as the printer is concerned, and all of the intelligence that runs the engine can be found on the controller card, which is powered by a Motorola 68020 running at 16.7 MHz. PC Magazine Labs' printer tests clocked the LaserPrinter 10L at 8.9 ppm in text mode and 2.6 graphics pages per minute in HP PCL 4 graphics mode. Though this doesn't compare at all with speed results presented by vendors like Hewlett-Packard Co. or QMS, IBM claims its network implementation of the LaserPrinter 10L will solve your print-speed anxieties. The IBM way? Simply buy two.

The LaserPrinter 10L is certainly priced low enough for some people to purchase a network duo, and it supports direct network adapters for Token-Ring ($945) and Ethernet ($845) environments. These adapters are each able to support two printers. By IBM's reasoning, this gives you a rated network print speed of 20 ppm. There is, however, a limitation to this approach: Although connected to the network by one adapter, the printers will not be recognized as one machine. Thus, as a user, you'll be assigned one printer,

IBM LaserPrinter 10L

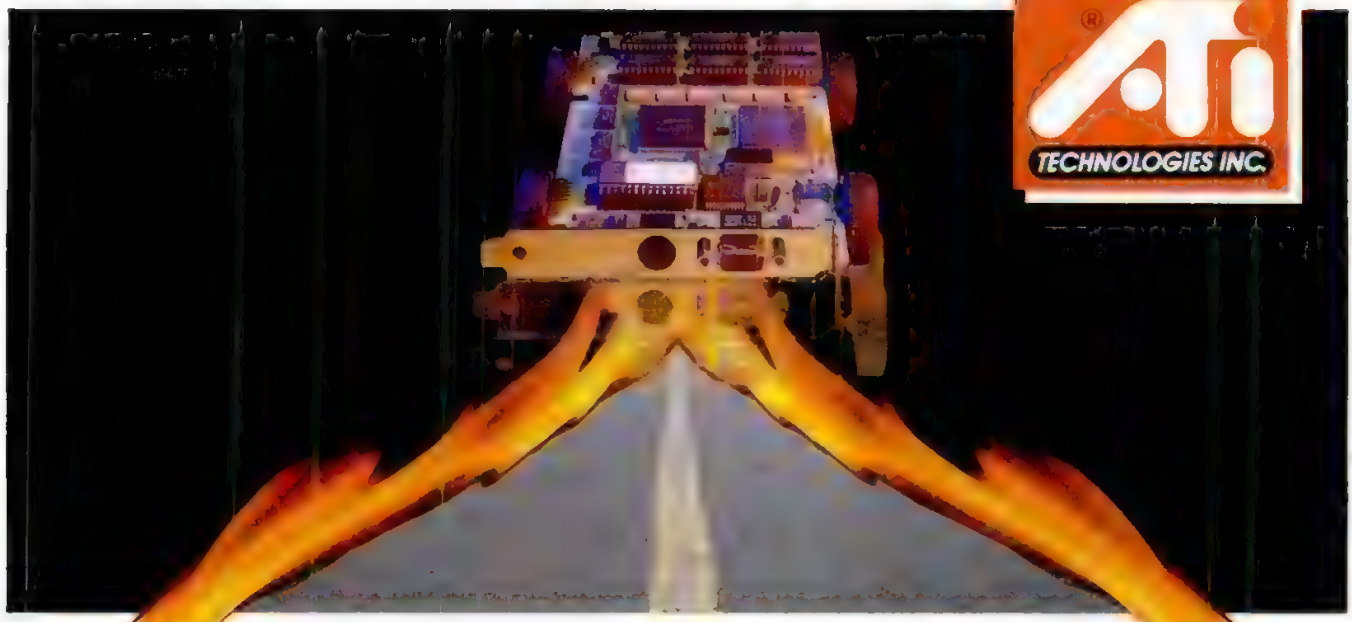
TEST RESULTS



Shared laser scores

In Short: The 10-ppm IBM LaserPrinter 10L is the slowest shared laser reviewed, but it is the cheapest, at $2,995. Once you purchase all the options to make this a viable network machine (memory upgrades, a LAN adapter, and the $199 HP PCL 5 or the $799 Adobe PostScript board), the printer is not so cheap anymore.

The IBM LaserPrinter 10L does not have a PostScript mode.



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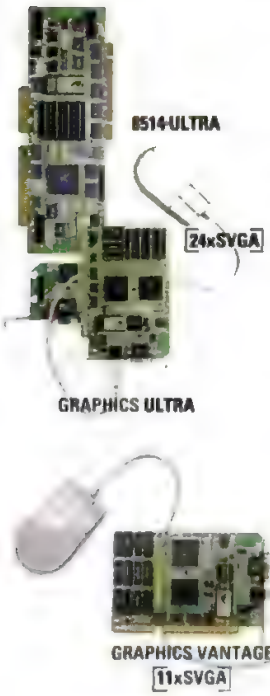

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CIRCLE 337 ON READER SERVICE CARD

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DKV

and if that machine's print queue is full, you won't be switched over to its partner.

600-DPI POSTSCRIPT

If you can live with the speed compromise, the LaserPrinter 10L has two internal emulation slots, which presently accept IBM's $499 Adobe PostScript board or its $199 PCL 5 card. The former emulation card provides only the basic 17 PostScript fonts. An additional 22 fonts can be added with a $399 font cartridge. You'll also need at least 2MB of RAM to run PostScript, which means you'll need the $199 1MB RAM upgrade. But PostScript adds a feature you won't find in many of the laser printers reviewed here this year (except IBM's other desktop lasers): 600-dpi printing.

Along with Adobe PostScript, the cartridge provides a 600-dpi mode, as it does for the LaserPrinter 6 and LaserPrinter 10 (but not the LaserPrinter 5e). To get 600-dpi resolution, you will need to buy at least 5MB of memory (a $799 4MB RAM upgrade); so it's hardly inexpensive, at $1,298 over the base-priced printer. However, there are no fancy tricks here. The controller actually modulates the laser to produce a smaller dot size and lay down toner in a 600-dpi pattern. The process

PostScript adds a feature you won't find in many laser printers: 600 dpi.

SHARED LASER PRINTERS: SUMMARY OF FEATURES

Products listed in alphabetical order

	Eastman Kodak Ektaplus 7016 PS	HP LaserJet IIISi	IBM LaserPrinter 10L	Kyocera F-5000A	LaserMaster TrueTech 1200
List price (tested configuration)	$5,795	$5,495	$2,995	$7,995	$14,995
PHYSICAL CHARACTERISTICS					
Dimensions (HWD, in inches)	16 x 38 x 21	17 x 22 x 24	17 x 14 x 21	13 x 42 x 19	14 x 37 x 21
Weight (pounds)	85	106	43	95	121
ENGINE					
Engine type	LED array	Laser	Laser	Laser	Laser
Model	Kodak LED QEXP-QT99	Canon	IBM proprietary	Kyocera LBP27	Hitachi Laserbeam 2000
Rated speed (pages per minute)	16	17	10	12	20
Single-cartridge toner/developer/drum	❑	■	■	❑	❑
Toner capacity (copies)	4,000	8,000	15,000	5,000	3,000
Memory (as tested)	2MB	1MB	1MB	3MB	17MB
Maximum resolution (horizontal by vertical dots per inch)	300 x 300	300 x 300	300 x 300	300 x 300	1,200 x 800
Controller with RISC processor	❑	■	❑	❑	■
INTERFACES					
Parallel	■	■	■	■	❑*
Serial	■	■	■	■	❑
AppleTalk	❑	■	❑	❑	❑
SCSI port	❑	❑	❑	❑	❑
Ethernet	❑	❑	❑	❑	❑
Token-Ring	❑	❑	❑	❑	❑
Automatic interface switching	❑	■	❑	■	N/A
Simultaneously active ports	■	❑	❑	❑	N/A
PAPER HANDLING					
Input-cassette capacity (sheets)	500	1,000	700	250	250
Letter-size paper (8.5 x 11 inches)	■	■	■	■	■
Legal-size paper (8.5 x 14 inches)	❑	■	■	■	■
B-size paper (11 x 17 inches)	❑	❑	❑	■	■
Output-cassette capacity (sheets)	200	500	250	150	250
Duplexing	❑	❑	❑	❑	❑
Rated maximum paper weight (pounds)	24	28	175	24	24
FONTS AND FEATURES					
HP PCL support	PCL 4	PCL 4, PCL 5	PCL 4	PCL 4	PCL 4
Supports scalable fonts	❑	■	❑	❑	❑
Accepts HP-compatible font cartridges	❑	■	❑	❑	❑
PostScript language support	Adobe Level 1	None	None	None	Microsoft TrueImage
Supports Type 1 fonts	■	❑	❑	❑	■
Supports automatic emulation switching	❑	❑	❑	❑	■
Accepts proprietary font cards	■	■	■	❑	❑

—Editors' Choice ■—Yes ❑—No * This product uses a video I/O interface.

N/A—Not applicable: The product does not have this feature.

does slow print speed down to a rated 8 ppm to help the laser's accuracy.

IBM ANSWERS HP

Even if you don't want the somewhat costly 600-dpi option, you'll benefit from PQET at 300 dpi. That's IBM's Print Quality Enhancement Technology, and it is similar to HP's Resolution Enhancement Technology. PQET (also found in all three IBM desktop lasers) provides anti-aliasing for the scalable-font technology and does an excellent job of eliminating the jaggies from large and very small type.

If you worry about duty cycle and printer life, think about this: The LaserPrinter 10L comes with a high-yield toner cartridge that will last for 15,000 characters at 2.5 percent coverage (roughly equivalent to double-spaced pages of text), and the printer itself is rated for 20,000 copies per month.

The LaserPrinter 10L comes with a standard one-year warranty on parts and labor, and there's also an optional $80 plan that will give you on-site service during the warranty period. Lexmark, the company that designed and built the printer for IBM, provides technical support through a toll-free hotline and will shortly be up and running with a 24-hour support BBS that will double as a source for new printer drivers.

Optioned out, the LaserPrinter 10L does get pricey—especially if you buy two. Fortunately, it doesn't need any options to do the job for which it was built. PCL compatibility and the 700-sheet paper capacity will easily fill the bill for most medium-size networks, and at that level, the LaserPrinter 10L is a bargain.

NCR 6436-0301	Printware Pro-III	QMS PS-2000	Sharp JX-9700	TI microLaser XL PS35
$7,995	$17,990	$15,995	$3,395	$3,149
18 x 22 x 29	44 x 23 x 13	28 x 37 x 26	11 x 16 x 17	11 x 16 x 17
88	142	187	52	55
Laser	Laser	Laser	Laser	Laser
Ricoh 4150	Copal SLB-6000	Ricoh M20	Sharp JX-97	Sharp JX-97
15	12	20	16	16
❑	❑	❑	❑	❑
6,000	5,000	20,000	5,000	6,000
12MB	12MB	8MB	1MB	1.5MB
300 x 300	1,200 x 600	300 x 300	300 x 300	300 x 300
❑	❑	■	❑	❑
■	■	■	■	■
❑	■	■	■	❑
❑	■	■	❑	❑
■	❑	❑	❑	❑
❑	❑	❑	❑	❑
❑	❑	❑	❑	❑
❑	■	■	❑	❑
■	❑	■	❑	❑
250	250	500	250	250
■	■	■	■	■
■	■	■	■	■
❑	■	■	❑	❑
250	250	1,500	250	250
❑	❑	❑	❑	❑
24	39	24	34	24
PCL 4	None	PCL 4	PCL 4	PCL 4
■	N/A	❑	❑	❑
❑	N/A	❑	❑	❑
None	Printware Printstyle	Adobe Level 1	None	Adobe Level 1
❑	■	■	❑	■
❑	❑	■	❑	❑
❑	■	❑	■	■

FACT FILE

IBM Corp./Lexmark, 740 New Circle Rd., Lexington, KY 40511; 800-426-2468.

IBM LaserPrinter 10L

List Price: $2,995; 1MB upgrade, $199; 2MB upgrade, $399; 4MB upgrade, $799; Adobe PostScript with 17 fonts, $499; additional Adobe PostScript cartridges, $399; HP PCL 5, $199; second paper cassette, $449; legal-size paper cassette, $79; large-capacity legal-size cassette, $139; auxiliary paper cassette, $279; envelope cassette, $379; label/card-stock tray, $69; Ethernet expansion interface, $845; Token-Ring expansion interface, $945.

Standard Warranty: One year on parts and labor; on-site service from IBM Corp./Lexmark, $80.

Dimensions (HWD): 17 x 14 x 21 inches.

Weight: 43 lbs.

Emulations: HPGL, HP PCL 4.

CIRCLE 620 ON READER SERVICE CARD

KYOCERA UNISON INC.

Kyocera F-5000A

by Kellyn Betts

Wide-carriage dot matrix printers may be commonplace, but their laser counterparts have been downright rare because of prohibitively high prices—until now. By dipping below the $10,000 threshold, Kyocera Unison's $7,995 Kyocera F-5000A is bringing 11- by 17-inch laser printing one step closer to the mainstream.

Though it has no built-in network adapter, Kyocera's top-of-the-line printer is full-featured enough to attract the workgroup crowd. Besides being able to

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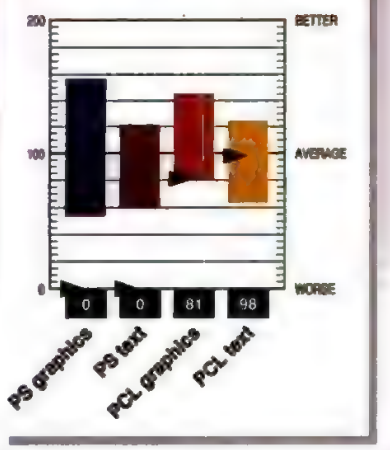
print through its serial and parallel ports simultaneously, it can switch among its eight emulations on the fly. If you exchange its internal 11- by 17-inch paper cassette for the one that fits 8.5- by 11-inch paper, the F-5000A can beat its own 12-page-per-minute rating by printing length wise instead of width wise. And a $1,995 dual-bin bottom paper cassette can sit beneath the printer to increase its capacity by two 500-sheet cassettes.

This is hardly the only printer Kyocera has poised to attract workgroups, though. In addition to three older, single-user laser printers, the company offers three lower-priced, narrow-drum lasers designed to entice shared audiences. The $5,995 F-3000A and the $4,995 F-1800A (the latter reviewed in "Lasers," *PC Magazine*, November 13, 1990) are the fastest of the bunch, with 18-ppm-rated engines (the F-1800A managed 15.2 ppm on the text speed test last year) teamed with the same combination of emulations and active ports you find on the F-5000A. The only difference between them is the number of 250-sheet paper cassettes they support: one for the F-1800A and two for the F-3000A. For heavy graphics use, there is the $4,995 Q-8010 option, which offers 15-ppm printing and three active ports as well as 4MB of video RAM and Kyocera's own PostScript interpreter.

Kyocera F-5000A

TEST RESULTS



Shared laser scores

In Short: The $7,995 Kyocera F-5000A takes 11- by 17-inch printing below $10,000, but it lacks a PostScript interpreter and needs a paper capacity upgrade, and its proprietary engine did not perform up to its 12-ppm rating. Although you can switch among eight emulations on the fly, the F-5000A lacks a direct network adapter.

The Kyocera F-5000A does not have a PostScript mode.

PERFORMANCE AND OUTPUT

On PC Magazine Labs' tests, the F-5000A outperformed its 12-ppm rating, coming in at 13.6 ppm on the HP PCL text speed test and a respectable 2.1 graphics pages per minute on the graphics speed test. This performance boost was mainly due to its Motorola 68020 processor.

Speedy as it may be, the F-5000A's output was somewhat lighter than the other printers in this product line; keep in mind that the review model Kyocera sent to us was perhaps atypical. In our experience, other Kyocera printers produce highly

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Kyocera F-5000A

satisfactory print, pointing to the likelihood that this deficiency is restricted to our review unit. Output was readable but marred by a difficulty in interpreting gray scales when the unit was running under its HP LaserJet II emulation.

CONSUMABLES AND SOFTWARE APPROACHES

Kyocera takes a multipart approach to printing elements. Instead of offering an all-in-one element as Canon does, which theoretically forces you to throw out your drum whenever you run out of toner, Kyocera's printers come with a separate drum, toner cartridge, and fusing element. Although the $49.95 toner cartridge needs to be replaced after printing an average of only 5,000 pages, the developer should last ten times as long (approximately 50,000 pages) and the fuser 20 times as long. Considering that the F-5000A is a wide-drum printer, this is not a bad deal, though the materials cost for Kyocera standard-width drums don't stack up quite as favorably against the price of Canon replacements.

Kyocera's printer-control software contains some notable features. The ability to change emulations on the fly can prove useful on a network, especially for CAD/CAM users using HPGL drivers, who might also want to print the occasional *WordPerfect* document with the LaserJet II driver. A command can be embedded in documents to remotely select which paper cassette is used, while other commands allow the printer's firmware to be reprogrammed. All commands, including those used to select from the printer's five resident fonts, are executable from DOS. Fonts and many other features can also be selected through the printer's control panel with the help of its two-line LED, but having the option to program is always useful, especially when the printer is being shared.

Recognizing that conformity makes sense in some areas, Kyocera wisely revised its warranty, bringing it up to the industry-standard one year on parts and labor. The company's packaging and manuals remain above average, as does the quality of its construction.

If you're a CAD/CAM or DTP user—or someone who favors large spreadsheets—the Kyocera F-5000A represents a reasonably priced solution. It's a great alternative to noisy dot matrix printers as a preplot or pretypeset printer, and coupled

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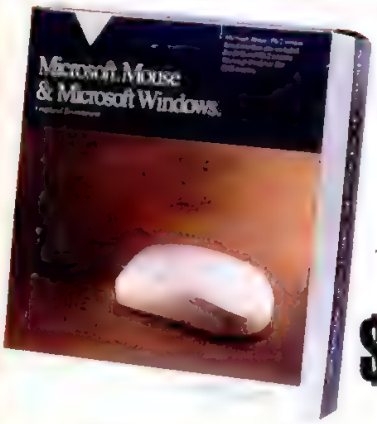

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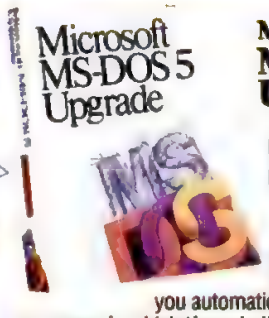

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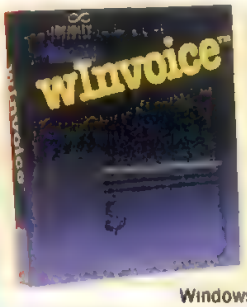

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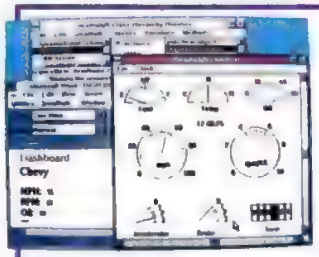

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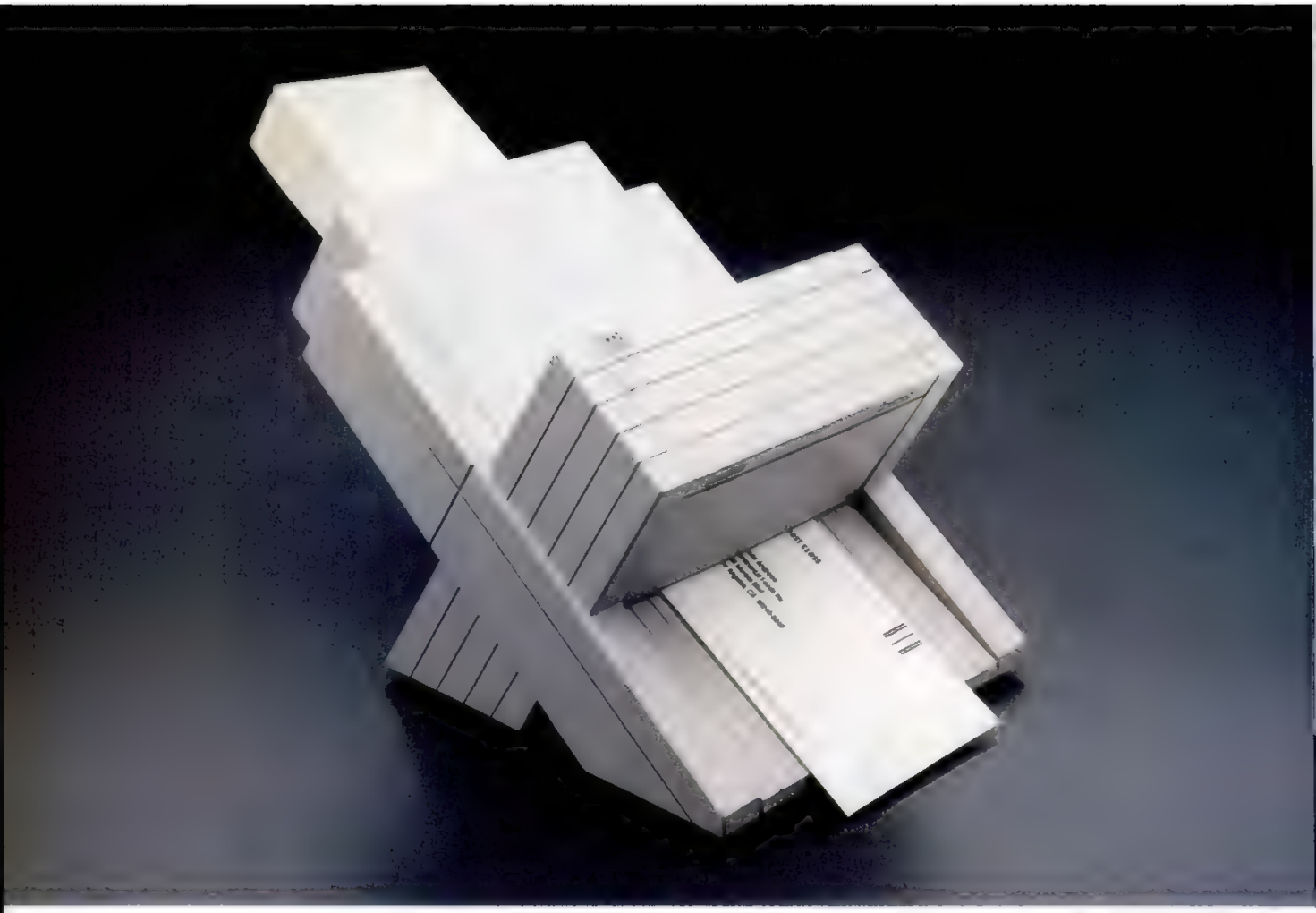

Actual size: 8.7" x 8.5" x 8" (HWD)

Introducing the AddressWriter. The amazing new printer that takes the aggravation out of printing envelopes, postcards and labels.

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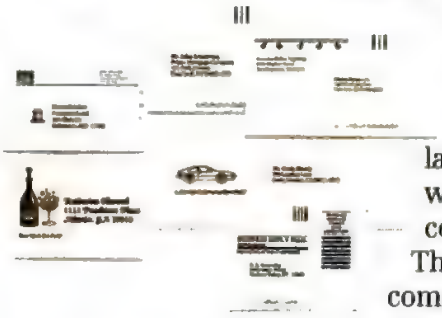
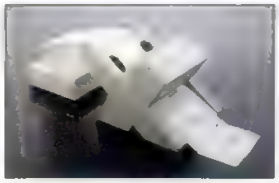


This neat little printer will shoot out a beautifully printed envelope, postcard, or label, complete with postal bar code, in seconds. The AddressWriter comes with its own memory resident addressing software compatible with DOS,® Windows,™* and Netware® applications. With one keystroke, you can set the software to *automatically* find the address in your letter, and print an envelope while your laser printer is printing your letter. Or you can set the AddressWriter to print the envelopes of a mail merge file while your laser printer prints the letters. If all you need are envelopes, print from the AddressWriter's built-in database, or from your favorite program.



It becomes a great label printer with $75 label feed attachment

The AddressWriter comes complete with printer, envelope catcher, software, cable and manual. Retail price is $595.

For more information or the name of a dealer near you, call 1-800-4-COSTAR.

*Windows application support in early 1992. Macintosh software is included. 220/240v model also available
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CO STAR

CIRCLE 166 ON READER SERVICE CARD

with the optional paper feeder, it's a good all-around machine for sharing. If large output isn't a requirement, you can do better elsewhere in both price and shared performance.

FACT FILE

Kyocera Unison Inc., 100 Randolph Rd., Somerset, NJ 08875; 800-323-0470, 908-560-3400.
Kyocera F-5000A
List Price: $7,995; 1MB memory board, $429; additional 1MB RAM upgrades (7MB maximum), $245; additional font cartridges, $215 each; dual-bin bottom paper cassette, $1,995.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 13 x 42 x 19 inches.
Weight: 95 lbs.
Emulations: Diablo, Epson FX, HPGL, HP LaserJet II, HP PCL 4, IBM Proprinter, Line Printer, NEC Pinwriter.

CIRCLE 621 ON READER SERVICE CARD

LASERMASTER TECHNOLOGIES CORP.

LaserMaster TrueTech 1200

by Alfred Poor

The LaserMaster TrueTech 1200's Hitachi engine is rated at 20 pages per minute (depending on paper size), which definitely qualifies it as a shared laser printer. And with a list price of $14,995 (rarely discounted), it's hardly in danger of becoming a commodity product, and at more than a yard wide, the TrueTech 1200 is too big for most desks anyway.

RESOLUTION INCREASE

The clue to this 121-pound behemoth's mission lies in its output. With a claimed resolution of 1,200 by 800 dots per inch—along with the ability to handle 11- by 17-inch paper—the TrueTech 1200 is designed to serve as a desktop typesetter. Its speed and capacity makes it ideal for sharing among several users who need to take advantage of its high resolution. LaserMaster Technologies Corp. also offers a similar product based on the same engine, the TrueTech 400XL, which offers 400-dpi resolution for $9,995 and can be upgraded to a TrueTech 1200 by swapping the controller card.

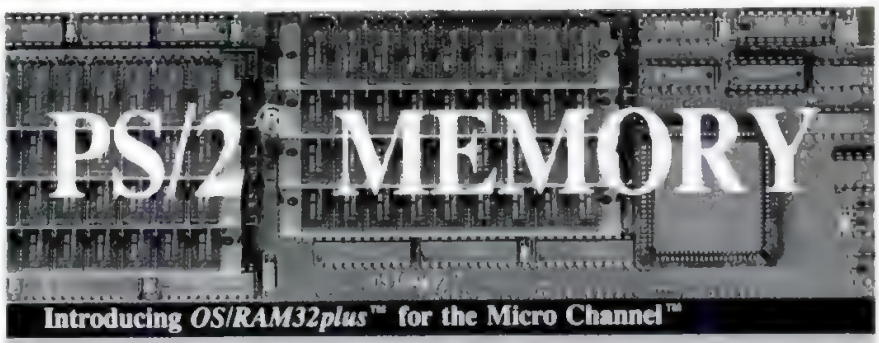
There are two basic components to the TrueTech 1200: the printer itself and a separate controller card installed in the PC. As in previous LaserMaster products, the print controller is contained on an expansion card, complete with its own CPU and 17MB of RAM. This design puts no additional load on the computer's resources; the card is configured as a parallel port and, according to LaserMaster, can be installed in either a file server or a print server on most networks.

Unlike past LaserMaster products, the new TrueTech 1200 line of printers uses the Microsoft TrueImage PostScript interpreter. This means you no longer need to rely on LaserMaster's proprietary drivers for specific applications such as *Microsoft Windows* or *Ventura Publisher*. The TrueTech 1200 comes with the standard complement of 35 font outlines.

OUTPUT AND PERFORMANCE

What is not standard, however, is the True-Tech 1200's output resolution. The printer is capable of 1,200- by 400-dpi resolution (in draft mode), and the controller card is able to modulate the pixel density to achieve an effective 1,200-by-800 resolution, which LaserMaster calls TurboRes mode. The output in both modes is excellent; jaggies on curves are just barely noticeable under a microscope in draft mode, and the TurboRes output smooths out all but the tiniest bumps. The higher resolution is able to support higher-density halftone screens than a 300-dpi printer for gray-scale images; our test graphic was created with a 53-line-per-

LaserMaster TrueTech 1200



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CIRCLE 151 ON READER SERVICE CARD

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inch screen, but the TrueTech 1200 could manage a 71-line-per-inch screen—a dramatic output improvement.

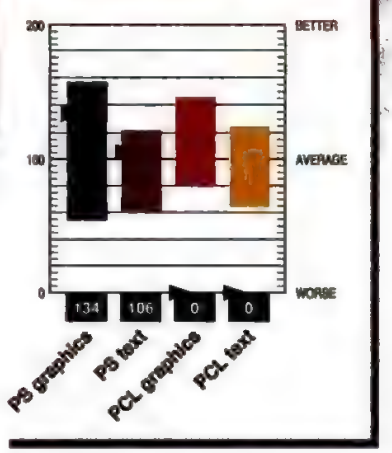
Performance is not hampered by this high resolution, which is impressive when you consider that 1,200-by-800 resolution represents more than ten times as many dots as a standard 300-dpi laser. In draft mode, the printer produced 14.9 ppm on PC Magazine Labs' PostScript text speed test and 1.32 graphics pages per minute on the graphics speed test. The TurboRes mode slowed down the output a bit (11.8 ppm for text and 1.08 gppm for graphics). These are still impressive times for any PostScript printer, not even considering the dramatic resolution increase.

The weakest part of the product is the initial installation. The procedures are complex and are not well documented. Since careless handling of the components can cause serious damage to expensive consumables, LaserMaster would do well to strengthen this aspect. On the other hand, the standard one-year warranty includes 90-day on-site service for repairs.

Not every user has a need for typeset-quality output from a shared laser or for 11- by 17-inch printed pages. If you have a group of users who need the extra resolution or paper size offered by the LaserMaster TrueTech 1200, it's probably your best bet.

LaserMaster TrueTech 1200

TEST RESULTS



Shared laser scores

In Short: The $14,995 LaserMaster TrueTech 1200 is based on a 20-ppm Hitachi engine and offers a 1,200- by 800-dpi resolution. While not the best solution for large multipurpose networks, its Microsoft TrueImage PostScript emulator makes it ideal for multiuser access to high-resolution laser output.

The LaserMaster TrueTech 1200 does not have a PCL mode.

FACT FILE

LaserMaster Technologies Corp., 7156 Shady Oak Rd., Eden Prarie, MN 55344; 612-944-9330.
LaserMaster TrueTech 1200
List Price: $14,995; legal-size paper cassette, $150; A3- and A4-size paper cassettes, $150 each.
Standard Warranty: One year on parts and labor, with on-site service from LaserMaster Technologies Corp. for the first 90 days.
Dimensions (HWD): 14 x 37 x 21 inches.
Weight: 121 lbs.
Emulations: HP PCL 4, Microsoft TrueImage PostScript interpreter.

CIRCLE 622 ON READER SERVICE CARD

NCR CORP.

NCR 6436-0301

by Jonathan Matzkin

While small, personal laser printers have sprouted like mushrooms on business desktops everywhere, there are still plenty of reasons for users to share heavy-duty departmental or workgroup printers. NCR Corp.'s $7,995 6436-0301 laser printer is certainly intended to do the bidding of more than one user, providing competitive speed and a SCSI interface.

Hardly a svelte unit, the 6436 measures 18 by 22 by 29 inches and weighs in at a portly 88 pounds. With its 15-page-per-minute-rated Ricoh 4150 engine, one-page print buffer (expandable to two pages), and 500-sheet standard paper-handling capability, the NCR 6436-0301 certainly has the aptitude to support multiple users. Its parallel and SCSI interfaces can be used simultaneously; it keeps track of incoming data from each interface and assigns the output from each to a different side of the top-mounted output tray. NCR says that selling prices average 20 to 30 percent lower than the 6436's list price.

NCR 6436-0301

THE SCSI ISSUE

NCR differentiates the 6436 by touting its SCSI port; indeed, it was the only shared laser featuring such an interface. However, the benefits you'll derive from this capability are still relatively minor. Sure, if you're hooked up and printing large desktop publishing files, a SCSI port's 5MB-wide datapath may free up your PC sooner, but at least for the moment, that PC had better be a member of the NCR System 3000 PC family, as only those computers (and their proprietary MCA SCSI controllers) will recognize NCR's SCSI driver. NCR claims that drivers for alternative PCs and SCSI controllers are in the works, but it couldn't give us a date. Part of the problem is that the SCSI interface still lacks a definite standard.

OUTPUT AND UPGRADES

The 6436's excellent output quality, wide selection of internal typefaces, and simple front-panel controls make it an easy-to-use source of excellent output. Nine standard printer emulations include Epson FX, HPGL, and IBM Proprinter, but surprisingly, the 6436 lacks a PostScript interpreter. At press time, NCR was planning to remedy this glaring deficiency in September by replacing the 6436 with an upgraded model that will support PostScript and carry a significantly lower list price of $6,795. There is also no envelope cassette available for the 6436; additional paper cassettes are available from the manufacturer in legal, letter, and A4 sizes for $72.45 each.

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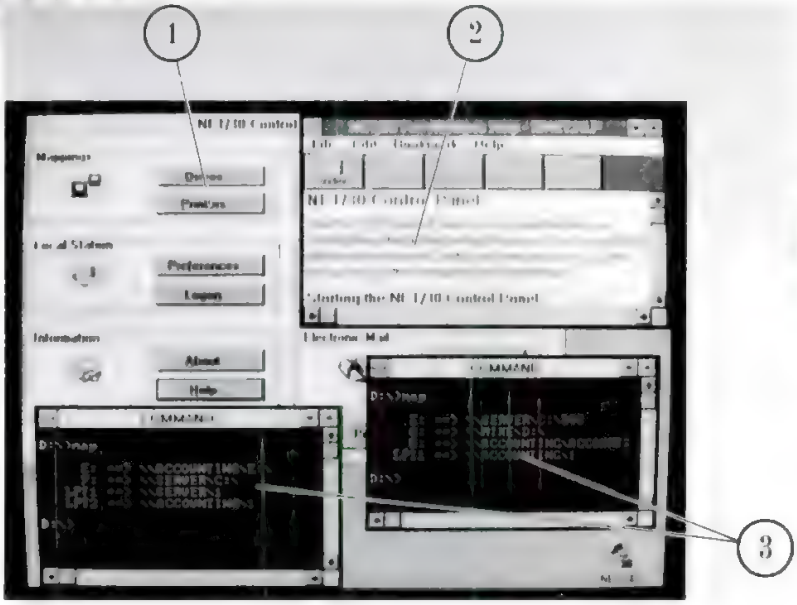

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2. NET/30 Help System includes context-sensitive help plus a complete on-line reference manual. Hypertext lets you quickly find what you need.

3. This example shows how each DOS window can access a different set of network disks and printers. With NET/30, each DOS window is a separate network station. Run multi-user applications in several DOS windows while sharing data and resources. It's just like running on separate computers.

CIRCLE 228 ON READER SERVICE CARD

the NCR 6436-0301's text and graphics output is excellent. Blacks are very dark and even, while details are clear and sharp.

SETUP AND CONTROLS

Setting up the 6436 is about as much fun as putting together any laser; the photoconductive unit and toner are installed separately. NCR's clear documentation smooths the process. NCR includes separate manuals for site preparation, installation, and general operation.

The main components of the 6436's front control panel are a 16-character LCD (with a contrast adjustment slider—a sophisticated touch), a row of illuminated icons that display system status and error conditions, and a group of six slightly raised flat-membrane keys. Five of the keys have functions mapped to them, and the sixth, a Shift key, allows each to support an additional function.

Selecting emulations, typefaces, and other options is simple, and the LED panel is refreshingly easy. The icons, by contrast, are cryptic, so repeated references to the documentation will be necessary.

OUTPUT AND PERFORMANCE

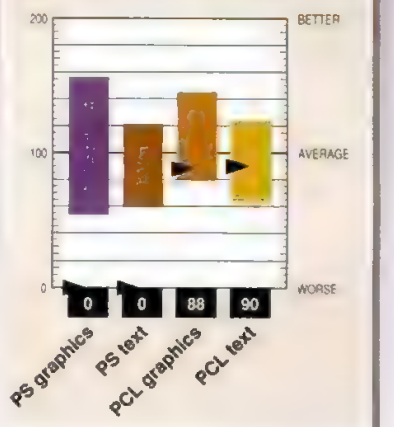
The 6436's output is excellent. Our test graphic, a scanned photograph, was printed with great contrast. Blacks are very dark and even, while details are clear and sharp, a useful quality for the 6436's positioning as a high-end desktop publishing printer. The extreme blackness was also noticeable in its text output. It goes beyond the standard typefaces in its emulations and offers ten scalable typefaces that can be printed with a variety of enhancements.

The 6436's Ricoh 4150 engine is rated at 15 ppm, and the printer came fairly close to that on our tests: It clocked in at approximately 12.4 ppm on the PCL text speed test, while managing 2.3 graphics pages per minute on the graphics speed test.

The NCR 6436-0301 has the rugged construction, speed, and high-quality output necessary for shared use. Its PostScript deficiency should be remedied by the time you read this, but if your mouth watered over the SCSI interface and you don't use NCR computers, don't get ready for dinner yet.

NCR 6436-0301

TEST RESULTS



Shared laser scores

In Short: The $7,995 NCR 6436-0301 is a fast, flexible laser printer designed for shared environments. It provides excellent print quality and a SCSI port, but the SCSI port is compatible only with NCR's System 3000 family of PCs. Furthermore, the printer currently lacks any type of PostScript support and has only a 250-sheet paper capacity.

The NCR 6436-0301 does not have a PostScript mode.

FACT FILE

NCR Corp., 1700 S. Patterson Blvd., Dayton, OH 45479; 800-225-5627.

NCR 6436-0301

List Price: $7,995; 1MB RAM upgrade, $500; 2MB RAM upgrade, $1,000; letter-size paper cassette, $72.45; legal-size paper cassette, $72.45; A4-size paper cassette, $72.45.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 18 x 22 x 29 inches.

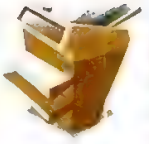
Weight: 88 lbs.

Emulations: Diablo, Epson FX, HPGL, HP PCL 4, IBM Proprinter, Line Printer.

CIRCLE 623 ON READER SERVICE CARD

PRINTWARE INC.

Printware Pro-III



by Alfred Poor

The Printware Pro-III is certainly a unique printer, based on its 1,200- by 600-dot-per-inch resolution and ability to handle 11- by 17-inch paper. But its individuality does not soften the blow delivered by its $17,990 list price, nor does it help to mitigate this printer's other problems.

The Pro-III is built around a Copal SLB-6000 print engine, which weighs in at 114 pounds and is rated at 12 pages per minute—only in landscape mode. But there's even more hardware: A separate controller unit, housed in a standard AT-style computer case, adds 28 pounds to the system. The controller uses the Printware Printstyle PostScript interpreter.

Installation is not particularly complex, though it does take time. The controller can attach to a parallel, serial, or AppleTalk port and will allow the simultaneous use of a Macintosh and a PC. Preparing the print engine is a bit tricky, and it's easy to spill developer during installation; indeed, the printer used to be installed only by field technicians, but Printware recently started selling it as a user-installable product. Note that the printer comes standard with only an 11- by 17-inch paper cassette; if you want to print on letter-size pages, you'll have to feed them manually or purchase an optional $179 paper cassette.

UNREMARKABLE SPEED

Once you get the printer installed and running, the print jobs are produced fairly quickly, but not as fast as expected from a printer with such a fast engine. On PC Magazine Labs' tests, the Pro-III produced 8.5 ppm on the PostScript text speed test and 0.6 graphics pages per minute on the graphics speed test. These are only slightly faster than some 300-dpi PostScript printers with 8-ppm-rated engines, yet the Pro-III is rated at 12 ppm. Printware acknowledged this slowdown and explained that the printer's rated speed was measured in landscape mode, not the portrait mode used in PC Labs' tests. In portrait mode the printer is rated at only 9 ppm.

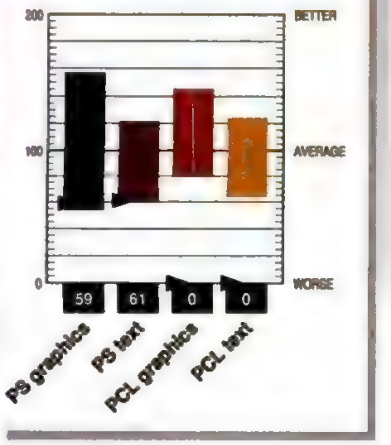
the Pro-III's high resolution eliminated most of the jaggies and produced a good halftone image.

The relatively low speed and high price might be acceptable if the print quality were excellent, but this was not the case with our test pages. The high resolution managed to eliminate most of the jaggies and was able to produce a good halftone image using a 71-line-per-inch screen, but the toner failed to produce large areas of solid black. There were some areas that were faintly gray, and line edges were not always crisp.

Even if the print quality of the Pro-III were perfect, it would be difficult to recommend. Its price is higher than those of printers with comparable resolutions and

Printware Pro-III

TEST RESULTS



Shared laser scores

In Short: The $17,990 Printware Pro-III offers 1,200- by 600-dpi resolution with a 12-ppm engine. Unfortunately, its performance is slow, its features are limited, and the price is higher than competing products with higher resolutions, more features, and faster speed. Better alternatives are available.

The Printware Pro-III does not have a PCL mode.

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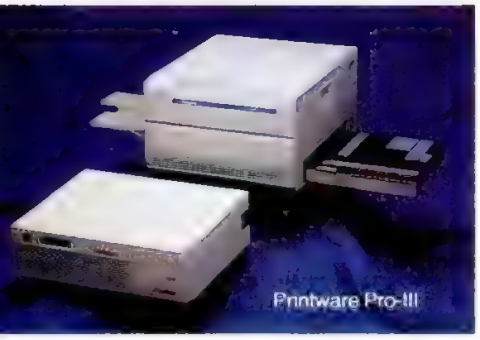


faster engines. It has only a single paper cassette where competing designs have two. And the separate controller in a computer case takes up an unnecessary amount of extra real estate. Even if you need the typeset-quality output the Printware Pro-III can produce, you can easily find better values elsewhere.

FACT FILE

Printware Inc., 1385 Mendota Heights Rd., St. Paul, MN 55120; 800-456-1616, 612-456-1400.

Printware Pro-III

List Price: $17,990; 4MB RAM upgrade (32MB RAM maximum), $490; 105MB hard disk, $1,350; 210MB hard disk, $2,225; legal-size paper cassette, $179; A3-size, A4-size, B4-size, and B5-size paper cassettes, $179 each; face-down tray, $590; large-capacity paper cassette, $2,990; second paper cassette, $1,190; ICL, $2,000.

Standard Warranty: 90 days on parts and labor.

Dimensions (HWD): 44 x 23 x 13 inches.

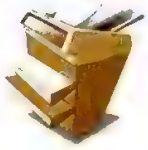
Weight: 142 lbs.

Emulations: Printware Printstyle PostScript interpreter.

CIRCLE 624 ON READER SERVICE CARD

QMS INC.

QMS PS-2000



by M. David Stone

The $15,995 QMS PS-2000 with its 20-page-per-minute Ricoh M20 engine earns gold stars in the shared laser department for power plus a whole lot more. With high-capacity and duplexing options (allowing for 1,500 sheets), B-size print capability, a large buffer, an optional external or internal hard disk, auto-sensing across its parallel, serial, AppleTalk, and optional Ethernet interfaces, and both Adobe PostScript and HP PCL 4, this is one printer that will handle just about anything your network can dish out.

PRICEY BUT LOADED

The high-end label applies to price, too. As tested, complete with its high-paper-capacity and duplexing option, the unit costs $19,490 ($15,995 base price, plus $3,495 for the high-capacity duplexing option). Clearly, you won't see this printer on the home shopping channel any time soon. Yet if the choice is between the PS-2000 and 15 or 20 desktop printers, the PS-2000 could qualify as a bargain.

Much of the PS-2000's price stems from its paper-handling features. These core capabilities of the Ricoh engine include two 250-sheet input cassettes, two 750-sheet facedown output trays, and a straight-through output tray for heavy-weight paper. The $3,495 high-capacity option adds a 1,000-sheet input cassette, along with duplexing.

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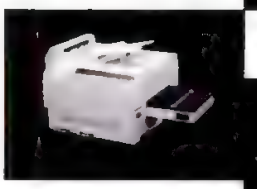

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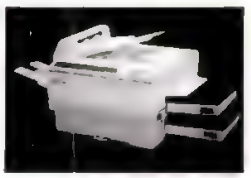

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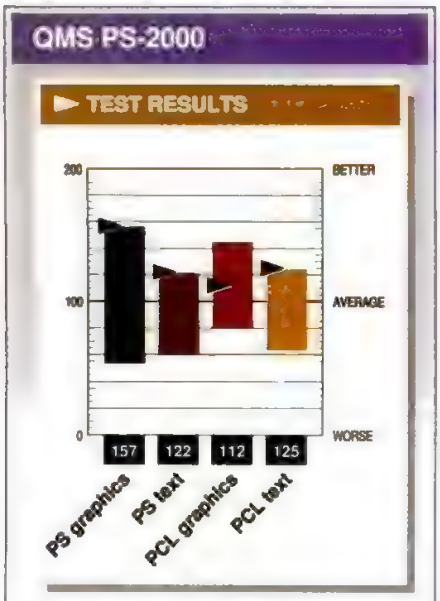
MORE FEATURES

Features include such niceties as the option to designate a particular input cassette for a given print job, letting you keep different-size paper in each bin or chain the cassettes together. You can also designate an output tray for each print job, so you might have two different departments, each printing to its own bin. Within the cassettes, each print job is offset somewhat from the one before so you can more easily find the output you're looking for.

Yet another useful feature is that each input cassette can handle several paper sizes. As shipped, one is designed for letter- or legal-size paper and the other for letter-, legal-, or ledger-size. The high-capacity cassette can handle A5- to legal-size paper. The only notable oversight is the absence of any way to print envelopes.

The features list continues with functions such as automatic jam recovery, which is the ability to reprint a jammed page automatically and continue with the print job; also consider the built-in printer-sharing features. The unit includes parallel, serial, and AppleTalk ports, and you can attach computers to each of these. The printer will automatically sense activity on any port and accept the print job. You can get an optional, high-performance TCP/IP Ethernet interface for $1,995.



Shared laser scores

In Short: The $15,990 QMS PS-2000 offers enough features to fulfill anyone's wish list, including a 20-ppm engine, heavy-duty B-size paper handling, Adobe PostScript, HP PCL 4, auto-sensing, a 500-sheet capacity (expandable to 1,500 sheets), a 25-MHz MIPS 3000 RISC processor, a built-in print buffer for spooling multiple print jobs, and the fastest laser performance this year.

the QMS PS-2000 performed heroically on PC Magazine Labs' tests. It was the fastest shared laser printer on text speed tests.

HARD DISKS AND AUTO-SENSING

Far more significant is the PS-2000's built-in buffer, which puts most printer-sharing devices to shame. The unit can buffer print jobs both to memory and to its optional hard disk, even as it's processing other print jobs with its 25-MHz MIPS R3000–based controller. The basic memory is substantial at 8MB and is upgradable to 12MB for $495 or 16MB for $995. The optional SCSI hard disks include a 40MB internal disk for $995, a 120MB internal disk for $1,795, a 20MB external disk for $995, and a 40MB external disk for $1,495. With buffering capabilities like this, you'll have to work hard to overrun the printer's capacity. The hard disk can also store soft fonts.

Another important capability is ESP mode, an auto-sensing feature that lets the PS-2000 automatically switch emulation modes. Both Adobe PostScript and PCL 4 are standard, as is HPGL and the CCITT Group IV data compression format. DEC LN03 is available as part of a $1,995 DECnet option.

You can force the printer into any emulation mode, but in ESP mode it monitors the data stream and adjusts itself automatically. This auto-sensing feature is not, however, 100 percent accurate, as we discovered on one of our output tests. While using the PostScript emulation, we set the printer to the IBM high-order character set, which it couldn't handle. But our test sent this character set without an identifying string (most print jobs will have an identifier preceding the data that tells the printer which emulation the data is using). Had the string been there, the PS-2000 would have recognized it and used it to switch to the proper emulation.

LOOK! UP IN THE SKY . . .

Aside from this minor flaw, the PS-2000 performed heroically on PC Magazine Labs' tests. It was the fastest shared laser printer on the text speed tests in both Adobe PostScript and PCL emulations, scoring 17.1 ppm on the PostScript text and 1.6 graphics pages per minute on graphics, while producing 17.2 ppm in PCL text mode and 2.9 gppm (second only to the HP LaserJet IIISi) in graphics mode.

As you might expect, the PS-2000 is physically similar to a free-standing office copier. The tested unit came with a warning that it should be installed by a technician, whom QMS provided. However, the standard housekeeping tasks, such as adding toner, are simple and straightforward. QMS provides on-site service for the 90-day warranty period.

On our tests, the QMS PS-2000 lived up to its promises, with blazing speed, outstanding print quality, and a host of network-enhancing features such as auto-sensing, super high-capacity duplexing, and multiple interfaces. With the intelligent design and superb execution, if you need a heavy-duty shared printer, this is the one to get.

FACT FILE

QMS Inc., One Magnum Pass, P.O. Box 81250, Mobile, AL 36689; 800-523-2696,

QMS PS-2000

If you have upgrades in mind and you're sure you don't need PostScript, Sharp has a selection of font cartridges.

205-633-4300.

EDITORS' CHOICE

QMS PS-2000

List Price: $15,995; 4MB RAM upgrade, $495; 8MB RAM upgrade, $995; 40MB internal SCSI hard disk, $995; 120MB internal SCSI hard disk, $1,795; 20MB external SCSI hard disk, $995; 40MB external SCSI hard disk, $1,495; duplexing high-capacity option, $3,495; DECnet with DEC LN03 emulation, $1,995; TCP/IP Ethernet, $1,995.

Standard Warranty: 90 days on parts and labor, with on-site service from QMS.

Dimensions (HWD): 28 x 37 x 26 inches.

Weight: 187 lbs.

Emulations: Adobe PostScript, HPGL, HP PCL 4.

CIRCLE 625 ON READER SERVICE CARD

SHARP ELECTRONICS CORP.

Sharp JX-9700

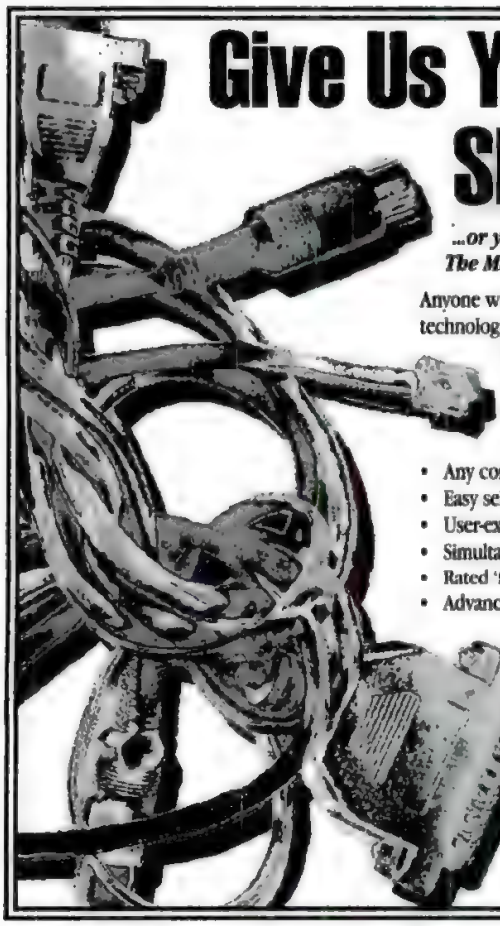
by John R. Quain

If you thought buying a shared laser printer meant finding an extra cubicle, think again. The 16-page-per-minute $3,395 Sharp JX-9700 uses only 11 by 16 by 17 inches of desktop space. The JX-9700's internal paper cassette can handle only 250 sheets, and the printer doesn't offer all the sophisticated multiuser features that larger lasers reviewed in this issue include, but its 14.7-ppm tested text speed and five emulations make it a solid, inexpensive printer for small workgroups. Although dealer and mail-order discounts are difficult to gauge, price reductions on other laser printers from Sharp Electronics Corp. indicate that buyers may see discounts of 30 percent or more on the JX-9700.

For six years, Sharp has produced laser printer engines for other companies, and since 1988, it has also been marketing its own laser printers. Consequently, this year's printer issue includes Sharp's top-of-the-line JX-9700 and the $3,149 TI microLaser XL PS35. Both use Sharp's 16-ppm JX-97 laser engine and the same basic chassis. Texas Instruments, however, offers its own controller as well as a PostScript option. Sharp supplies neither a PostScript option nor an AppleTalk interface.

OPTIONS AND FEATURES

If you've got upgrades in mind and you're sure you don't need PostScript, Sharp does have a selection of memory cards, font cartridges, and paper-handling options. The JX-9700 comes with 1MB of memory, and proprietary memory card upgrades, ranging in price from $379 for 1MB to $1,699 for 4MB, are available. The JX-9700 also has two proprietary slots for font



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CIRCLE 290 ON READER SERVICE CARD

Sharp JX-9700

cartridges to augment its standard Courier and Line Printer typefaces. Sharp sells a variety of font cards priced from $195 to $275.

The standard 250-sheet cassette of the JX-9700 can handle letter- or legal-size paper. However, if you intend to share this printer, purchasing Sharp's optional $479 500-sheet feeder, which fits neatly under the printer, would be a wise investment. An optional 40-envelope cassette is available at the same price. For unwieldy print tasks, such as transparencies and heavier paper weights (up to 34 pounds), there's a front paper slot that will automatically override the cassette feeder when paper is inserted by hand.

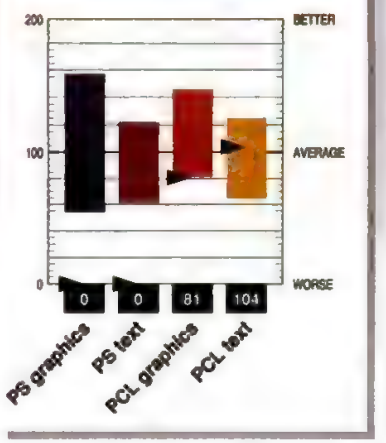
Setting up and replacing the JX-9700's three consumables—toner ($89), photoconductor drum ($199), and developer cartridge ($269, with toner)—are uncomplicated.

When first unpacked, the Sharp JX-9700 has the photoconductor drum and developer cartridge already installed. To replace these consumables, all the user has to do is install the toner and developer. Thankfully, this is a simple operation and one that can be performed without wearing gloves.

Sharp rates the JX-9700's cost per page at 2.7 cents, less than the 3 cents per page of many personal printers but more than the HP LaserJet IIISi's 2 cents per page. The recommended page-per-month duty of the JX-9700 is conservatively rated at 15,000 copies.

Sharp JX-9700

TEST RESULTS



Shared laser scores

In Short: A small-footprint laser founded on Sharp Electronic Corp.'s 16-ppm engine, the $3,395 Sharp JX-9700 offers rapid HP PCL 4 printing and high-quality output for those with limited space and modest finances. It lacks advanced shared features, contains only a 250-sheet paper capacity, and offers no PostScript options.

The Sharp JX-9700 does not have a PostScript mode.

OPERATION AND PERFORMANCE

Contributing to the JX-9700's ability to serve several masters is its eight-button control panel and 16-character LCD. An easily understood series of menus allows users to reset most functions quickly, including communications, emulations, fonts, symbol sets, slashed zero, and paper sources. The congenial control panel meant that changing the printer's setup for PC Magazine Labs' tests took us only a few seconds.

In its default HP LaserJet Series II emulation, the JX-9700 produced a top text speed of 14.4 ppm, less than its rated 16 ppm but better than many comparably rated machines. Our graphics test, performed in the same mode, slowed the paper rate down to an unremarkable 2.1 graphics pages per minute.

The Sharp JX-9700 remained unperturbed by PC Labs' HP PCL 4 torture test, and even though bitmapped curves appeared slightly rougher than those produced by genuine LaserJets, the Sharp JX-9700's print quality is still superior to many HP emulators.

Compared with more-expensive shared laser printers from competing companies such as Hewlett-Packard Co., Kyocera Unison Inc., and QMS, the Sharp JX-9700 is short on multiuser communications features. It includes a Centronics parallel port and a 19.2-bpi RS-232C serial port, but it does not offer simultaneous operation of both interfaces, nor does it allow input auto-sensing. Sharp does include a free TSR utility to switch the printer's emulation remotely. But unlike HP's LaserJet IIISi, for example, Sharp doesn't offer Ethernet or Token- Ring options to operate the printer as a network node.

Compared with more-expensive shared laser printers from Hewlett-Packard, Kyocera Unison, and QMS, the JX-9700 is short on multiuser communications features.

Although the Sharp JX-9700 doesn't deliver all the user-sharing options of larger, pricier printers, it does offer quick, quality printing for offices that must reconcile themselves to limited space and limited budgets. Sharp supports the JX-9700 with a one-year parts-and-labor warranty as well as a toll-free tech support line for end users.

FACT FILE

Sharp Electronics Corp., Sharp Plaza, Mahwah, NJ 07430; 800-732-8200, 201-529-9600.

Sharp JX-9700

List Price: $3,395; 1MB RAM upgrade, $379; 1.5MB RAM upgrade, $519; 2.5MB RAM upgrade, $929; 4MB RAM upgrade, $1,699; HP-UV–equivalent font cartridge, $250; HP-Z–equivalent font cartridge, $275; additional font cartridges, $195 each; 500-sheet paper cassette, $479; executive-size paper cassette, $69; invoice-size paper cassette, $69; envelope cassette, $479;

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 11 x 16 x 17 inches.

Weight: 52 lbs.

Emulations: Diablo, Epson FX, HP PCL 4, IBM Graphics Printer, IBM Proprinter.

CIRCLE 626 ON READER SERVICE CARD

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THE X-12 INTRODUCTION

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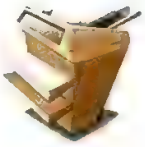
TEXAS INSTRUMENTS INC.

TI microLaser XL PS35



by John R. Quain

Laser printers with different vendor banners often use the same engine. Consider Texas Instruments' TI microLaser XL PS35. This $3,149 Adobe PostScript printer uses the 16-page-per-minute-rated Sharp Electronics Corp. laser engine and the 11- by 16- by 17-inch small-footprint chassis featured on the $3,395 Sharp JX-9700. The microLaser XL distinguishes itself by containing its own controller and Adobe PostScript, all for less money (Sharp doesn't even offer a PostScript upgrade). Dealer discounts of up to 30 percent will doubtless tempt PostScript followers to the TI camp.

TI microLaser XL PS35

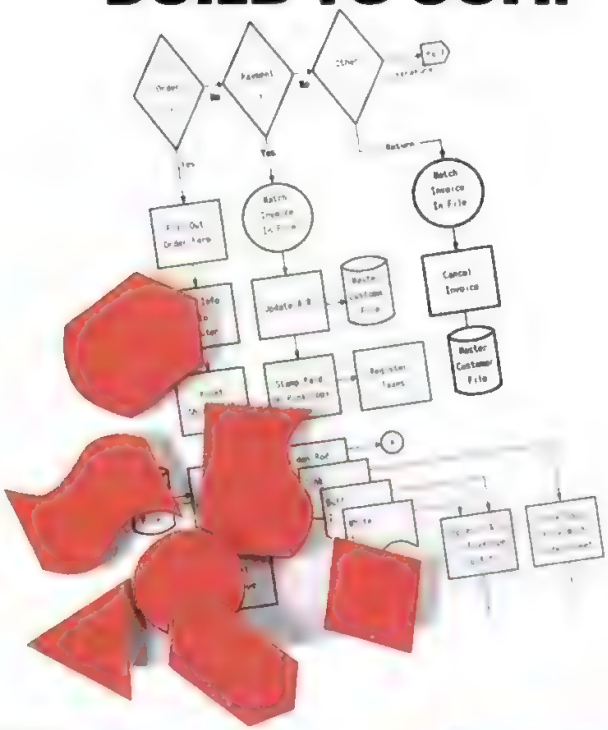
SHARP SIMILARITIES

In its standard configuration, the microLaser XL comes with 1.5MB of memory, 35 scalable PostScript fonts, and an HP LaserJet II emulation (with Courier and Line Printer fonts). Though it includes the two most pervasive and powerful laser printer emulations (HP and PostScript), the standard configuration lacks the backward-compatibility of Sharp's four additional dot matrix emulations and includes only one Centronics parallel port and no serial port. Diablo, Epson FX, and IBM Proprinter emulation cards are available from TI for $135 each. Our test unit included the $100 AppleTalk interface and $35 RS232C serial port (19.2 kilobits per second) options.

The TI microLaser XL lacks the backward compatibility of Sharp's dot matrix emulations.

By necessity, the microLaser XL uses the same three-part consumable system (toner, developer, and photoconductor drum) and has the same paper-handling abilities as the Sharp JX-9700, including the internal 250-sheet (letter or legal size) paper cassette. The microLaser XL's control panel also uses a similar 16-character LCD and menu system to set printer parameters such as emulation and port selection.

BUILD TO SUIT.



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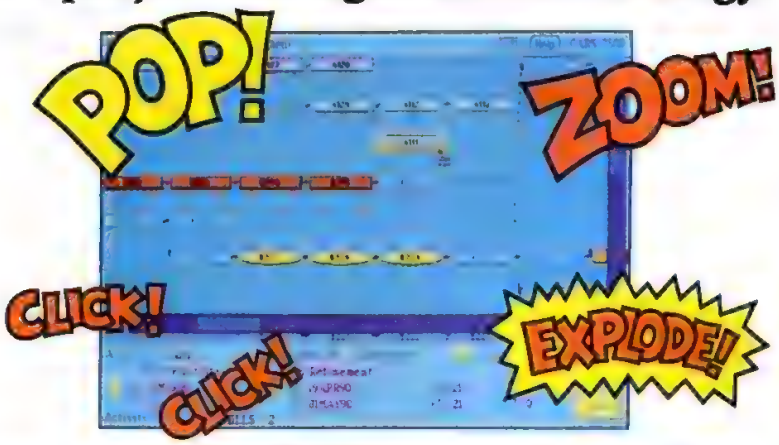

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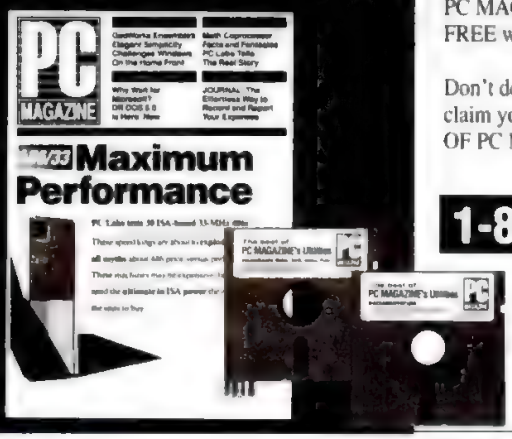

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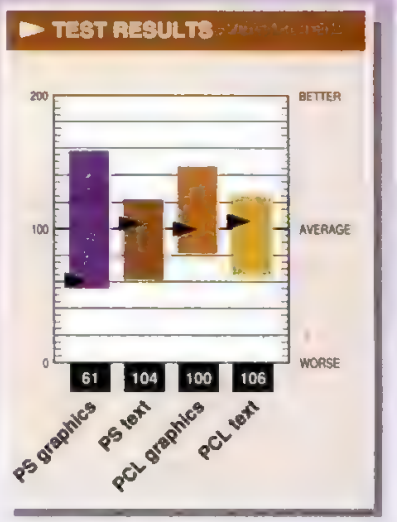
PERFORMANCE SURPRISE

The microLaser XL turned in marginally faster speeds than the identically powered Sharp JX-9700. In PCL, the microLaser XL delivered 14.7 ppm on the text speed test and 2.6 graphics pages per minute on the graphics speed test. Print quality was comparable with the Sharp JX-9700's output, but TI also offers all the enhancements of PostScript. Using that option will improve the look of documents and graphics and will slow the printer only slightly, to 14.6 ppm and 0.6 gppm.

A persistent "Cover Open" message initially thwarted the microLaser XL's printing efforts on our tests. According to TI, a mechanical part in subsequent models should correct the problem. Current owners can have the new part installed on-site by contacting TI or can take the printer to an authorized service center.

If you're looking for a fast HP-emulation-only laser printer, TI offers the microLaser XL in a basic XL configuration with 512K for just $2,399. Do 35 PostScript fonts sound excessive? TI also sells the

TI microLaser XL PS35



Shared laser scores

In Short: Built on the 16-ppm Sharp JX-97 engine, the $3,149 TI microLaser XL PS35 offers the advantage of more speed than the Sharp JX-9700 printer and includes Adobe PostScript—for less money. As a shared printer, it will not accommodate simultaneous multiuser communications, but for the price and size it should appeal to small businesses.

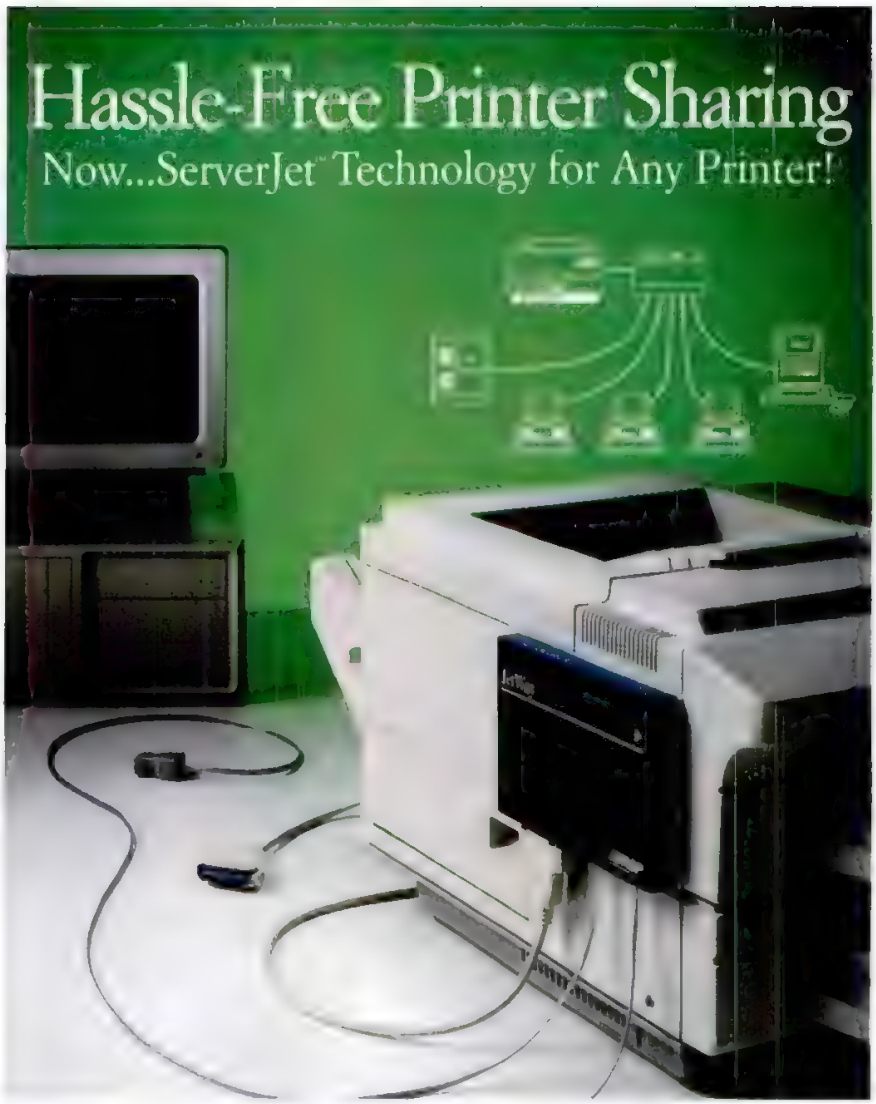
the TI's options are less expensive than Sharp's, including the cost of consumables.

microLaser XL PS17 (with 1.5MB) for $2,799 with only 17 fonts. If you decide you need PostScript after buying the basic XL, you can purchase the PS17 upgrade for $400 or the PS35 upgrade for $700 (both include 1MB of memory) and install it yourself. In addition, this fall TI expects to ship a $3,649 Turbo model of the microLaser XL using a RISC processor and including HP PCL 4, PostScript Level 2, and 2.5MB of memory.

TI's microLaser XL PS35 has not only the same 16-ppm engine as Sharp's JX-9700 but also its shared-printer limitations. It can't manage simultaneous input from different users or perform auto-sensing. Generally, TI's options are less expensive than Sharp's (1MB of memory is $239 from TI and $379 from Sharp), including the cost of consumables, lowering TI's estimated cost per page to 2.4 cents versus Sharp's 2.7 cents. That fact, topped with the microLaser XL PS35's low PostScript price and excellent print speed, will convince many buyers that TI has improved on a successful design. ■

FACT FILE

Texas Instruments Inc., Information Technology Group, P.O. Box 202230, ITG-9128, Austin, TX 78720; 800-527-3500.
TI microLaser XL PS35
List Price: $3,149; 1MB RAM upgrade (4.5MB maximum), $239; AppleTalk interface, $100; Hewlett-Packard font cartridges, $135 to $205; Diablo, Epson FX, and IBM Proprinter emulation cartridges, $135 each; envelope cassette, $345; large-capacity paper cassette, $345.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 11 x 16 x 17 inches.
Weight: 55 lbs.
Emulations: Adobe Postscript, HP PCL 4.
CIRCLE 527 ON READER SERVICE CARD



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CIRCLE 111 ON READER SERVICE CARD

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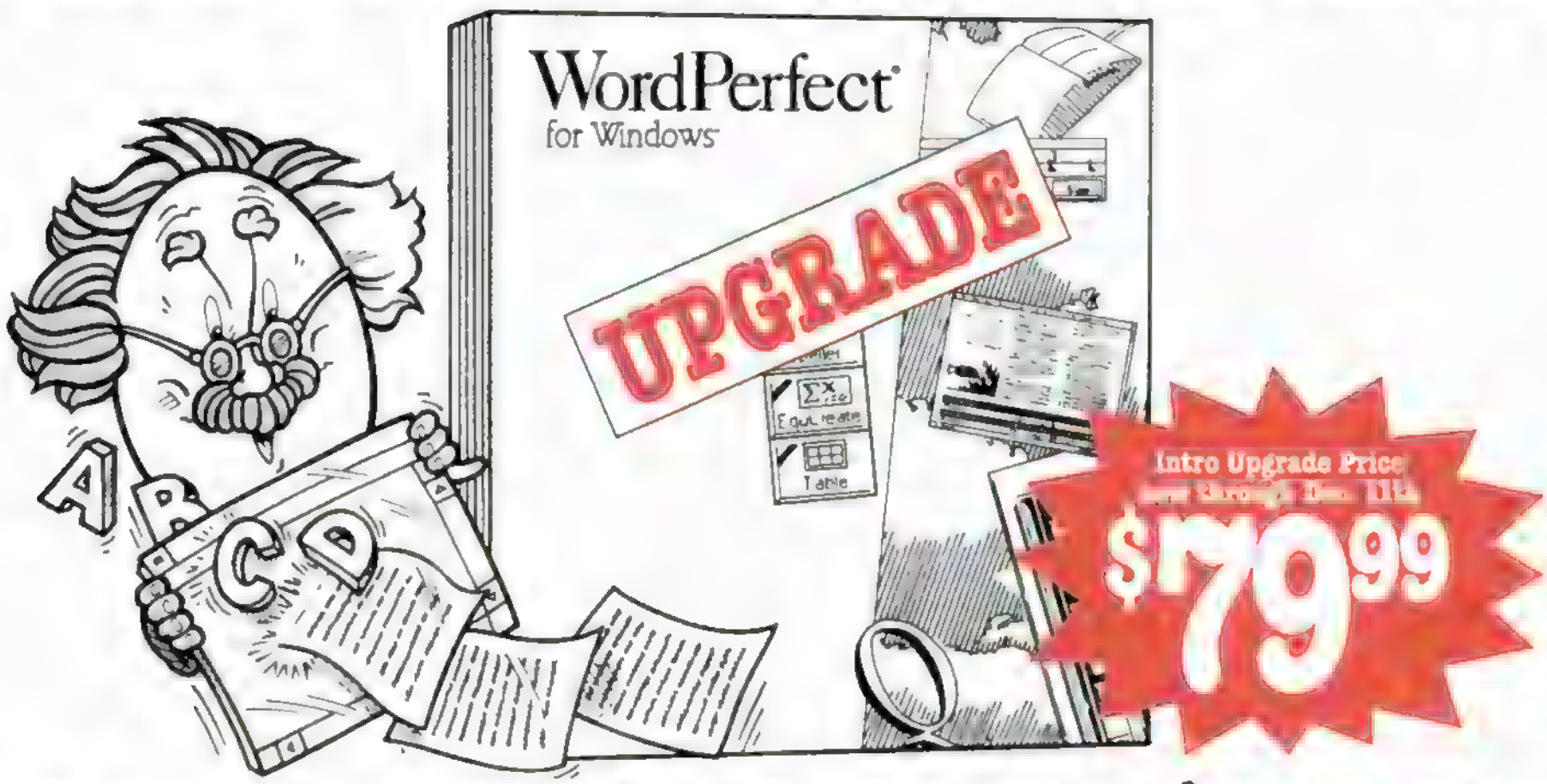

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CIRCLE 227 ON READER SERVICE CARD

Color PostScript

SOLID INK STAGES A COMEBACK

by WINN L. ROSCH

PHOTOGRAPHY: RICK BECKER

All nine of these color PostScript printers deliver spectacular four-color output. But only one of them lets you print on plain paper: the Tektronix Phaser III PXi. It uses solid ink-an old technology with a new, more promising implementation.

Once considered too expensive and too high-end to be reviewed in *PC Magazine*, color PostScript printers are back for their third roundup in this issue. The new aspects are lower prices than ever before, more players, and a new, promising technology: solid ink.

Color PostScript printers are still at the high end of the printer market, but they're much less expensive

than they were two years ago when we first looked at them ("Color Page Printers: Affordable at Last," *PC Magazine*, November 14, 1989). At that time we found only three priced under $10,000. At the end of last year, we looked at four color PostScript printers, priced between about $8,000 and $9,000 ("Color Page Printers: Putting a Rainbow on Your Desk," December 25, 1990). In this issue, we review nine color PostScript printers between about $7,000 and $13,000.

What's more, these printers produce dividends for corporate art departments and graphics service bureaus by cutting the cost of making prepress color proofs and color transparencies for presentations. For less than $1 per page, any of these printers can achieve what 3M Colorkeying does for about $35. And in preparing output for presentations, they bring a brilliance to transparencies that you won't get from other office printers.

Eight of the nine printers reviewed here use thermal wax transfer technology: the CalComp ColorMaster Plus 6603PS, General Parametrics Spectra*Star 430, NEC Colormate PS Model 40, Océ Graphics G5241-PS, QMS ColorScript 100 Model 10p, Seiko ColorPoint PSX Models 4 and 14, and Tektronix Phaser II PXi. The ninth printer, the Tektronix Phaser III PXi, uses a solid-ink technology that its manufacturer calls "phase-change printing."

HOT WAX

Thermal wax printers melt wax from a carrier variously called an ink sheet, transfer sheet, or ribbon, and press it against specially treated paper or transparency media where the ink solidifies. The Phaser III PXi works more like a classic ink jet printer, but instead of spraying an ink based on a volatile solvent that sets through evaporation or absorption, it melts a wax-based ink that cools and hardens onto the printing medium. The Phaser III PXi has two and a half advantages over thermal wax machines: It can use plain paper (all thermal wax printers require treated paper), it can print nearly to the edges of each sheet (thermal wax printers leave wide margins), and sometimes—perhaps half the time—it costs less per page.

Although the color PostScript printers produce excellent black-and-white output as well as color printout and transparencies at laser-printer resolution (300 dots per inch), for everyday use these printers are no substitutes for lasers. Where laser printers keep you waiting from 10 to 15 seconds per page, thermal transfer makes you wait about 22 seconds for a black-and-white printout, and over a minute for a color page. That's because each of the three or four wax colors laid on the printout takes a separate 22-second pass across the printhead. The solid-ink Phaser III PXi is even slower (about 2 minutes per page) because of its small, mobile printhead, which shifts back and forth dozens of times to spray ink across a full sheet (about 66 times for letter-size paper).

these printers produce dividends by cutting the cost of color proofs and color transparencies for presentations.

Thermal wax printers use stationary printheads as wide as a printout, and both the paper and page-wide ink sheets move across them. To print each color, the printhead melts the sheet's waxy ink from an area the size of the whole page being printed, no matter how much image is to be transferred. And once a page-size area of the sheet is used, no more ink can be printed from it. Consequently, printing a single four-color page requires four full pages of ink, no matter how much or how little of each color is printed. That makes the process far more expensive than laser printer output (plan on 2.5 cents for a laser page versus around 60 cents for four-color thermal wax).

SOLID INK

The solid-ink Tektronix Phaser III PXi consumes only the amount of ink that is sprayed on a page, so your ink costs are lower when you leave vast white areas on your printouts. But the Phaser III PXi's inks are so expensive that when you cover large areas with ink (for example, a page of solid color), you'll pay more for ink than with a thermal wax machine. Tektronix says that typical applications require 30 percent coverage, for an average cost per page of 25 cents (including consumables and plain paper)—less than half the cost of thermal wax color printers.

Tektronix is not the first company to try solid ink. The Howtek Pixelmaster (reviewed in the issue of November 14, 1989) used the technology. But this now-discontinued machine proved disappointing because its plastic-based inks hardened into a sandpaper texture on paper—and often hardened inside the printhead, causing hard-to-clean clogs. The Phaser III PXi printhead uses a novel new design to eliminate such clogging and incorporates a "cold fuser," a hard steel roller that presses the soft ink flat. It looks almost as good as thermal wax output but shows slight ink ridges every sixth of an inch, remnants of the individual passes of its printhead. As we went to press, Dataproducts Corp. announced a solid-ink color PostScript printer.

OFF REGISTER

One problem with color thermal wax printing is registration. The paper must be rolled past the printhead for each color printed. If the paper slips, the result is misregistration—rainbows of colors around the edges of lines and characters.

Three-color ribbons mean less danger of misregistration. The advantage of four-color ribbons lies in better color saturation and truer blacks. Where three-color ribbons create an approximation of black by mixing all the inks, four-color ribbons add black as the fourth color. This eliminates the need to overlay the three inks where black is desired, and it produces a truer black—but at a higher price since you are using an additional color sheet.

The printers attempt to minimize registration problems by using elaborate mechanisms to keep the paper from slipping. Most thermal wax printers clamp the paper between rubber rollers. The Tektronix Phaser printers and the General Parametrics Spectra*Star 430 wrap it around a drum for tighter control. The Phaser III PXi virtually eliminates the problem by spraying all colors from its printhead in the same pass.

One side effect of paper clamping is that thermal wax printers can't print on the part of the paper being held. Consequently, most of these machines are niggardly in terms of printed area. The Tektronix Phaser II PXi, for instance, prints an area only 8.1 by 8.8 inches on 8.5- by 11-inch letter-size paper. Seiko Instruments uses the sharpest technology

CalComp ColorMaster Plus 6603PS

$6,995

CalComp 6603 engine-based B-size thermal wax transfer printer with PhoenixPage PostScript compatibility. Uses a RISC processor.

PS TEXT SPEED	0.9 ppm
ONE PAGE OUT	76 sec.
PS GRAPHICS SPEED	0.3 gppm
PS GRAPHICS TIME	2 min. 54 sec.

Editor: a person employed
whose business it is to sep
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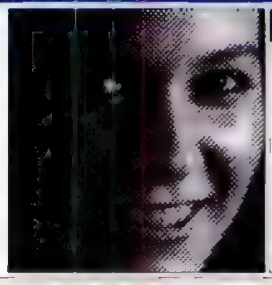
Palatino **Bold** Underline

General Parametrics Spectra*Star 430

$6,995

Sharp JX-560G engine-based thermal wax transfer printer with Pipeline PostScript compatibility. Uses a RISC processor.

PS TEXT SPEED	0.8 ppm
ONE PAGE OUT	74 sec.
PS GRAPHICS SPEED	0.3 gppm
PS GRAPHICS TIME	3 min. 44 sec.



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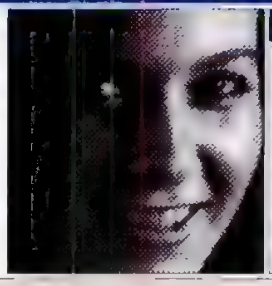
NEC Colormate PS Model 40

$6,995

NEC Colormate engine-based thermal wax transfer printer with Adobe PostScript.

PS TEXT SPEED	1.8 ppm
ONE PAGE OUT	35 sec.
PS GRAPHICS SPEED	0.5 gppm
PS GRAPHICS TIME	1 min. 50 sec.



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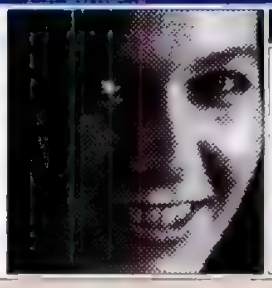
Oce Graphics G5241-PS

$8,990

Shinko 445 engine-based thermal wax transfer printer with Adobe PostScript.

PS TEXT SPEED	1.2 ppm
ONE PAGE OUT	52 sec.
PS GRAPHICS SPEED	0.5 gppm
PS GRAPHICS TIME	1 min. 55 sec.



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Palatino **Bold** Underline

QMS ColorScript 100 Model 10p

$6,995

Mitsubishi G370 engine-based thermal wax transfer printer with Adobe PostScript.

PS TEXT SPEED	1.2 ppm
ONE PAGE OUT	54 sec.
PS GRAPHICS SPEED	0.6 gppm
PS GRAPHICS TIME	1 min. 37 sec.

Editor: a person employed
whose business it is to sep
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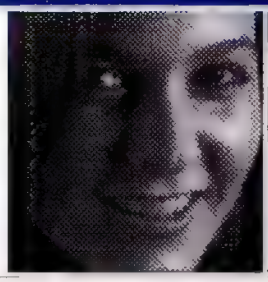
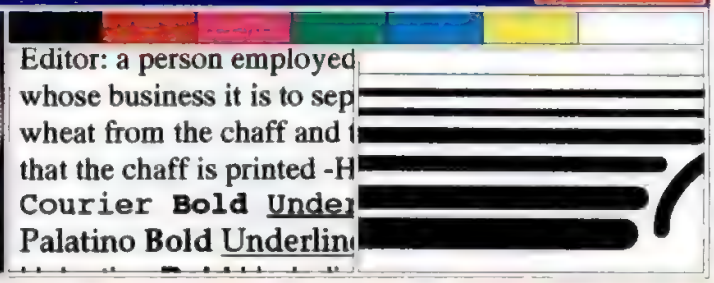
Courier **Bold** Under
Palatino **Bold** Underline

Seiko ColorPoint PSX Model 4

Seiko CH5504-DX10 engine-based thermal wax transfer printer with PhoenixPage PostScript compatibility. Uses a RISC processor.

PS TEXT SPEED 0.9 ppm
ONE PAGE OUT 70 sec.
PS GRAPHICS SPEED 0.5 gppm
PS GRAPHICS TIME 2 min. 05 sec.



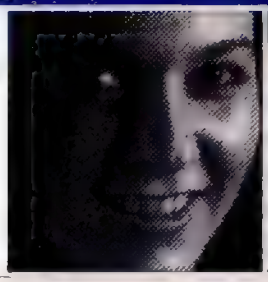


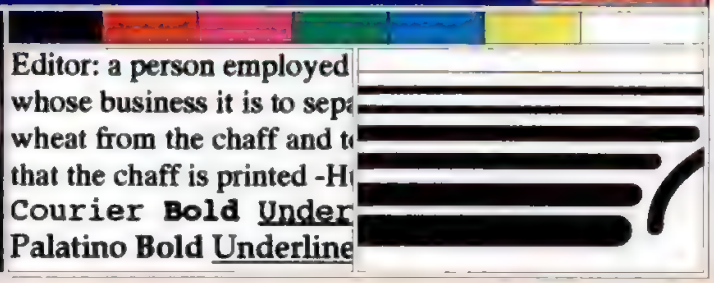
Seiko ColorPoint PSX Model 14

$12,999

Seiko CH5514-RX18 engine-based B-size thermal wax transfer printer with PhoenixPage PostScript compatibility. Uses a RISC processor.

PS TEXT SPEED 0.6 ppm
ONE PAGE OUT 93 sec.
PS GRAPHICS SPEED 0.4 gppm
PS GRAPHICS TIME 2 min. 37 sec.

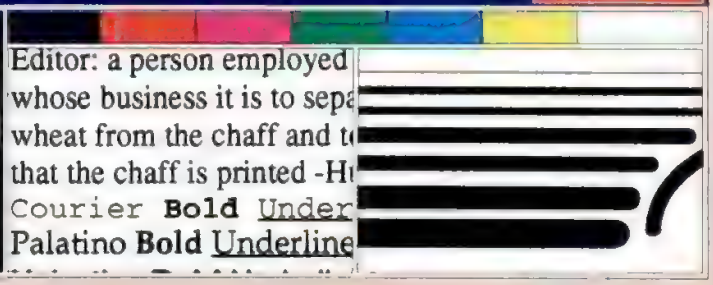




Tektronix Phaser II PXi

Sharp 4694 engine-based thermal wax transfer printer with Adobe PostScript Level 2. Uses a RISC processor.

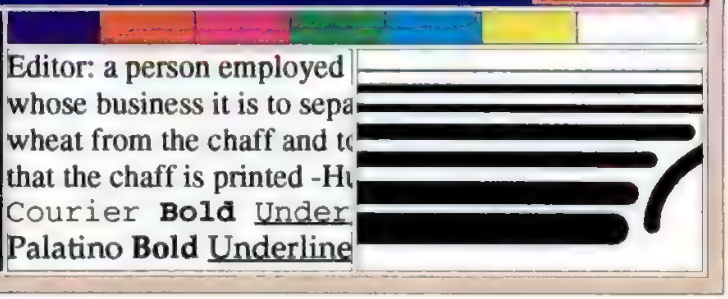
PS TEXT SPEED 1.2 ppm
ONE PAGE OUT 50 sec.
PS GRAPHICS SPEED 0.5 gppm
PS GRAPHICS TIME 1 min. 51 sec.



Tektronix Phaser III PXi

Tektronix 4698 engine-based B-size solid-ink printer with Adobe PostScript Level 2. Uses a RISC processor.

PS TEXT SPEED 0.5 ppm
ONE PAGE OUT 144.7 sec.
PS GRAPHICS SPEED 0.4 gppm
PS GRAPHICS TIME 2 min. 51 sec.



to maximize image size—an oversize sheet and a knife that trims off the unprintable area.

Despite the cost and sometimes modest image sizes, when quality counts wax delivers. All of these printers use translucent dyes of magenta, cyan, and yellow that allow one color to shine through another to produce intermediate hues (green, blue, and red) and black, a mixture of all three primary colors. By dithering, an electronic Pointillist technique that places different-colored dots next to each other, these printers can approximate as many as 16.7 million different hues.

The dithered colors are not as smooth and intense as pure tones, but they are more than adequate for previewing graphics before color separations are made for printing. In fact, all of these printers support Pantone color matching to assure you that the quality you see in the preview will match that of the final output. You can get a good idea of what will be printed before you send out the artwork.

POSTSCRIPT LEVEL 2

The biggest difference you'll find in these printers is not in what they print out—all deliver excellent quality—but in their controllers. All are based on Adobe PostScript or PostScript-compatible interpreters, such as PhoenixPage and Pipeline.

The different interpreters produce distinct results, which can be differentiated in text rendering because of their slightly different font designs.

The two Tektronix machines are the first color printers to bring Adobe PostScript Level 2 to the market. (And PostScript Level 2 is supported by only one laser printer in this roundup, the Dataproducts LZR 960.) Level 2 unifies and codifies many of the color extensions installed in various color PostScript machines, bringing standardization to this corner of the industry.

Most of these machines offer 35 or 39 standard fonts—essentially the same font set except that some machines support Helvetica Narrow, some Helvetica Condensed, and some both. The Helveticas look nearly identical to all but a typographer's eyes. The advantage of having both is to ensure the printer won't substitute Courier if your software asks for one that is not available.

Some manufacturers keep costs down by trimming the number of fonts included with their PostScript interpreters. For example, the NEC Colormate PS Model 40 offers only 17 fonts in its low-priced standard configuration. This keeps down the list price of the printer but sacrifices layout options.

RISC PROCESSOR POWER

Since processing power is needed to translate PostScript commands into rasters that can be printed, six of these machines use high-powered RISC-based microprocessors. (The NEC, Océ, and QMS models do not.) While a RISC processor should improve the speed of printing complex files, PC Magazine Labs' current test suite does not include files that exercise such processors fully.

Despite their different technologies and controllers, these machines are more alike than you might suppose. All deliver bright, saturated colors, deep blacks, and sharp, laserlike output. Quality differences are almost too close to call. Speed differences are application-dependent and may vary widely depending on what you plan to do; speed tests can't tell the whole story. Consequently, features can be the most important factor in your choice among these printers. You'll want to look carefully at fonts, paper handling, the printable area, and even the convenience of loading transfer sheets. While there's no one best color PostScript printer for all applications, you may find one that suits the way you work better than the rest.

PC MAGAZINE EDITORS' CHOICE

▪ Tektronix Phaser III PXi

High-quality color output doesn't come cheap. The nine color PostScript printers we tested this year cost roughly $7,000 to $13,000 list. All produce color output that is more than adequate for use by professional presenters, graphic artists, ad agencies, and designers—much better than what you get from far cheaper color ink jet or impact dot matrix printers that cost $500 to $2,000. Of the nine, the best combination of features, performance, and output quality belongs to the Tektronix Phaser III PXi, which stands alone in other ways as well.

The Phaser III PXi employs a unique solid-ink technology that allows you to print on virtually any kind of paper or film and still get quality output. You aren't restricted to the coated white stock or transparency film required by the eight thermal wax transfer devices. While solid-ink technology has been around before, Tektronix is the first company to make it work well, even on transparencies.

This $9,995 device boasts support for PostScript Level 2, Adobe's updated printing language, which includes backward compatibility with the current PostScript. It can print on 11- by 17-inch sheets (B-size paper) with only a small unprintable margin area; some other units will not let you print on the top 2 inches of the sheet. In setup and operation, the Phaser III PXi caused the fewest headaches for PC Magazine Labs' testers. Finally, while everyone knows that if you have to ask how much fuel costs, you shouldn't buy a yacht, we should note that the Phaser III PXi's per-page costs are substantially cheaper than any other printer's costs.

Honorable mention goes to the two Seiko ColorPoint PSX printers, the A-size Model 4 ($9,499) and the B-size Model 14 ($12,999). By a slight margin, their output quality surpassed that of the Tektronix Phaser III PXi, and the smaller unit was second-fastest among the nine printers in this group. But these Seiko color printers are expensive, and PC Labs found the roll-fed paper somewhat clumsy to use, even if it did maximize the printable area.

If you are somewhat cost-constrained, you'll be adequately served by one of the four units that list for $6,995: the CalComp ColorMaster Plus 6603PS, General Parametrics Spectra*Star 430, NEC Colormate PS Model 40, and QMS ColorScript 100 Model 10p. The CalComp accepts B-size paper, the QMS was the fastest of the nine on graphics printing, and the NEC and QMS use Adobe PostScript rather than a PostScript-compatible interpreter. Some users may feel more comfortable with genuine Adobe PostScript when producing complex images.

CALCOMP INC.

CalComp ColorMaster Plus 6603PS

Just when you're losing confidence in American industry, a printer like the ColorMaster Plus 6603PS from CalComp comes along. This is one in a line of thermal wax printers from the plotter division of CalComp, a wholly owned subsidiary of Lockheed Corp. Engineered and built in the United States, the ColorMaster equals other thermal wax printers in color and resolution (300 dots per inch) but surpasses most with its large printable area. The price, $6,995 with the factory-standard 6MB of RAM, is competitive enough that most dealers do not offer discounts.

The 6603PS uses Phoenix Technologies' PhoenixPage PostScript interpreter and includes all 39 standard PostScript fonts. CalComp also offers a printer with a raster interface, as well as a B-size PostScript-compatible unit, the $9,995

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Application Techniques ... NCP
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9435 ☐Publisher's Powerpak 2.1 for WordPerfect & Microsoft Word 49.

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7336 ⊡Label Pro 1.0 for Dot Matrix 49.
1600 Avery 1st Impression 229.

Berkeley Systems ... NCP
9885 ⊡After Dark 1.0A for Windows 29.

Bitstream ... NCP
7568 ⊡FaceLift 1.2 for Windows 2.x/3.0 59.
8040 ⊡FaceLift 1.5 for WordPerfect 5.0/5.1 59.
7569 ⊡Companion Value Pack 1.0 125.
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9695 ☐Borland's C++ 2.0 339.
1514 ⊡Paradox 3.5 529.
7356 ☐Pascal Pro *(2nd Edition)* 209.
9635 ⊡Object Vision 1.0 call

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Bitstream ... NCP
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8040 ⊡*FaceLift 1.5 for WordPerfect 5.0/5.1* $59.
7568 ⊡*FaceLift 1.2 for Windows 2.x/3.0* 59.

Central Point ... NCP
5039 ☐PC Tools 7.1 115.
8114 ⊡Backup 7 0 *(DOS and Windows)* 84
1675 ⊡Commute 1.0 84.
9751 ⊡AntiVirus 1.0 84.

Chipsoft ... NCP
1663 ⊡Turbo Tax Personal 1040 for DOS 9.0 49.
3517 ⊡Turbo Tax Personal 1040 for Windows 2.0 59
State Tax Packages
DOS ver... ea. 38. Windows ver... ea. 49

Chronologic Corporation ... NCP
8849 ⊡Instant Recall 1.2 64.

CompuServe ... NCP
7546 ⊡DOS Membership Kit 1.3 29.

Concentric Data Systems ... NCP
6575 ⊡R & R Relational Report Writer 4.0 159.

Corel Systems ... NCP
5506 ☐CorelDRAW! 2.0 389

Data Storm ... NCP
4798 ⊡PROCOMM PLUS 2.01 69.

Delrina Technology ... NCP
2446 ⊡WinFaxPro 2.0 75.
7351 ⊡PerFORMPRO 1 0 179

Digital Research ... NCP
9694 ☐DR DOS Upgrade to 5.0 39.

Fifth Generation Systems ... NCP
7725 ⊡Direct Access 5.1 65.
3950 ⊡Fastback Plus 3.0 119.

Fox Software ... NCP
6188 ⊡FoxPro 2.0 489.

Funk Software ... NCP
9488 ⊡Sideways 3.3 & P.D. Queue 1.0 85.

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Gibson Research ... NCP
9832 ⊡SpinRite II 2.0 64.

Great American Software ... NCP
9827 ⊡Money Matters 2.0 & Payroll 2.0 99.
4880 ☐One Write Plus Acct. Sys. 2.06 189.

Hayes ... NCP
7983 ⊡Smartcom Exec 2.0 79.
9639 ⊡LANstep 1.0 349.

hDC Computer Corporation ... NCP
8974 ⊡Icon Designer 1.0 35.

Helix Software ... NCP
9627 ⊡Netroom 2.0 *(single user)* 52.

Hilgraeve ... NCP
8204 ⊡HyperACCESS/5 2.0 *(DOS)* 59.

IBM ... NCP
2666 ☐DOS 5.0 Upgrade 59.
3073 Hollywood 1 0 for Windows *(3½" only)* 319.

Individual Software ... NCP
1328 ⊡Professor Windows 1 0 27.
6222 ⊡Resume Maker 1.3 29.

Inner Media, Inc. ... NCP
8846 ⊡Wide Angle 1 0 for Windows 69

Inset Systems ... NCP
7298 ⊡HiJaak 2.1 99.
7300 ⊡Inset Plus HiJaak 125.

Insight Development ... NCP
8320 ⊡PrinTools 1.0 85.

Intuit ... NCP
2426 ⊡Quicken 4.0 39.
2474 ⊡Quicken with QuickPay 65.

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5653 □1-2-3 2.3 ..... 349.
1852 □1-2-3 2.3 Upgrade ..... 95.
2755 □1-2-3 for Windows 1.0 419
2747 □1-2-3/W and Ami Pro Upgrade 159
5799 ⊡Ami Pro 2.0 309
1847 ⊡Ami Pro Competitive Upgrade 119
1621 □Freelance Graphics 4.0 for DOS ..... 349.
2750 ⊡cc:mail DOS Platform Pack ..... 125.
2748 ⊡cc:mail Windows Platform Pack ..... 325.
2749 ⊡cc:mail 25 user Pack ..... 379.

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4603 ⊡Andrew Tobias' Tax Cut 1991 ..... 49.

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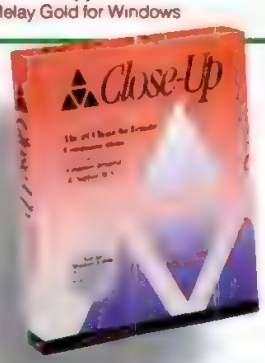
Microcom ... NCP
7649 ⊡Virex-PC 2.0 ..... 79.
6234 ⊡CarbonCopy Plus 6.0 ..... 119.
2718 ⊡Relay Gold for Windows 239



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2735 ⊡Works for Windows 2.0 139
2901 □Word 5.5 ..... 209.
7387 ⊡PowerPoint 2.0 for Windows 329
6195 ⊡Word 1.1 for Windows 329
2856 ⊡Excel 3.0 for Windows 329
8137 □Office 1.6 for Windows 499
2853 ⊡C Compiler 6.0 ..... 329.
1620 □DOS 5.0 Upgrade ..... 65.
1624 ⊡Visual Basic 1.0 139

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5122 ⊡For The Record 2.0 ..... 35.
2982 ⊡WillMaker 4.0 ..... 39.

Norton-Lambert ... NCP
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7860 ⊡Calendar Creator Plus 4.0 ..... 52.
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3220 □DESQView 2.3 ..... 85.
4586 □DESQView 386 2.3 ..... 145.

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4155 ⊡RightWriter 4.0 ..... 54.
1857 ⊡RightWriter 4.0 Network ..... 169.

Reality Technologies ... NCP
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6572 ⊡WealthBuilder 1.1 ..... 99.

Reference Software ... NCP
4396 ⊡Grammatik IV 2.0 ..... 59.
7483 ⊡Grammatik for Windows 2.0 ..... 59.

Roykore ... NCP
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8162 ⊡ABC Flowcharter 1.1 189

Sitka ... NCP
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3720 Flashcard 2.1 *(AppleTalk network card)* . 155.

Softlogic Solutions ... NCP
3542 □Software Carousel 5.0 ..... 55.

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9638 □Professional Write Plus 1.0 169
3482 □Harvard Graphics 3.0 ..... 419.
6600 ⊡Superbase 4 for Windows 1.3 ..... 529.

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9859 ⊡Word for Word/Windows 4.2 ..... 47.

Solution Systems ... NCP
7977 □Brief 3.1 *(Programmer's Editor)* ..... 189.

Spinnaker ... NCP
1415 ⊡PFS WindowWorks 1.0 129
7604 ⊡PLUS for Windows 2.0 ..... 289.

Stac Electronics ... NCP
1409 ⊡Stacker 1.1 ..... 89.
1408 ⊡Stacker 1.1 w/8-bit coprocessor card . 159.

Symantec ... NCP
6397 □The Norton Backup 1.2 *(Windows/DOS)* 89.
3146 ⊡The Norton Utilities 6.0 ..... 119.
3425 □Q&A 4.0 ..... 269.
7999 ⊡Norton Anti-Virus 1.0 ..... 89.
2359 □The Norton Desktop for Windows 105
8378 □PC Anywhere IV 4.03 ..... 125.

Systems Compatibility ... NCP
9046 □Complete Writer's Toolkit 1.1 ..... 85.
6564 □Software Bridge 5.0 ..... 79.

Teleware ... NCP
9847 ⊡M.Y.O.B. for Windows ..... 139.

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1270 □TimeSheet Pro 2.0 ..... 145.

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7420 ☐ Check It 3.0 ..... 89.
Traveling Software ... NCP
5179 ☐ LapLink III 3.0 ..... 95.
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7796 ☐ Publisher V 4.0 for Windows 569
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7781 ☐ LetterPerfect 1.0 ..... 129.
4214 ☐ WordPerfect Office PC ..... 89.
3804 ☐ WordPerfect 5.1 ..... 265.
6685 ☐ DrawPerfect 1.1 ..... 279.
WordStar International ... NCP
1482 ☐ Correct Grammar 1.0 for Windows 65
6791 ☐ WordStar Professional 6.0 ..... 199.
XTREE ... NCP
1202 ☐ XTree Easy 1.0 ..... 45.
6161 ☐ XTree Gold 2.5 ..... 95.
Z-Soft ... NCP
1626 ☐ Publisher's Paintbrush for Windows ..... 299.

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1836 ☐ Where in America's Past is Carmen Sandiego ..... 39.
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2763 *MicroTRAC*–Delivers top speed & precision with a footprint just ¾ the size of a business card. Features 3 wraparound buttons with "drag-lock" & adjustable resolution. Incl. serial & PS/2 interface for desktop or laptop .. $59.

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1334 ☐ Chuck Yeager Air Combat Trainer ..... 42.
3037 ☐ Secret Weapons of the Luftwaffe ..... 49.
7372 ☐ World Atlas 2.0 ..... 42.
3050 ☐ World Atlas for Windows ..... 57.
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☐ Word Torture for Windows ..... ea. 34
☐ Word Torture 3.0 ..... ea. 29.
Microsoft ... NCP
7881 ☐ Entertainment Pack for Windows 1.0 .. 29
2858 ☐ Flight Simulator 4.0 ..... 39.
8270 ☐ Aircraft and Scenery Designer 1.0 .... 29.
Microsoft Press (Books)
8129 Running Windows *(2nd Edition)* 22
8136 Running Microsoft Excel 22
Penton Overseas ... NCP
☐ VocabuLearn/ce Levels I & II (French, Italian, German, Spanish, Russian, Hebrew and Japanese) ..... *each* 35.
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9466 ☐ Space Quest IV *(VGA)* ..... 39.
7972 ☐ King's Quest V *(VGA)* ..... 45.
Software Toolworks ... NCP
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9860 ☐ Word for Word Professional 4.2 ..... 89.

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Stone & Associates ... NCP
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Strategic Studies Group ... NCP
☐ Civil War *(vol. 1, 2, or 3)* ..... ea. 27.
Toyogo ... NCP
2702 ☐ Go Junior for Windows 24
2701 ☐ Go Master for Windows ..... 39.
2703 ☐ Nemesis Deluxe Toolkit 5.0 ..... 75.
2704 ☐ Nemesis Deluxe Toolkit 5.0 for Windows. 75.
True BASIC, Inc. ... NCP
☐ Kemeny/Kurtz Math Series ..... *each* 45.
Walt Disney Computer Software ... CP
2629 ☐ Mickey's 123's ..... 35.
2624 ☐ Mickey's ABC's ..... 35.

HARDWARE

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American Power ... 2 years
7108 Smart UPS 400 ..... 339.
7105 Smart UPS 600 ..... 469.
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9822 Graphics Ultra *(w/1 MB)* ..... 559.
1838 Graphics Ultra w/VGA *(512K)* ..... 479.
2012 Graphics Ultra w/VGA *(w/1 MB)* ..... 619.
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9620 9600etc/e Modem ..... 379.
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7001 BOCARAM/AT PLUS *(0K)* ..... 119.
7150 BOCARAM/AT PLUS *(2 MB)* ..... 219.
7139 *(4 MB)* .... 329. 7138 *(8 MB)* .... 539.
6998 I/O Board for AT ..... 59.
6999 I/O Board for Microchannel *(S/S/P)* ..... 109.
8380 BasicVGA *(256K, 640 x 480)* ..... 63.
8381 SuperVGA *(1 MB, 1024 x 768)* ..... 145.
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7400 2 Position Laser Compatible Switch Box. 109.
Brown-Wagh ... 1 year
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2336 Creative Labs Sound Blaster Pro ..... 199.
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7897 BubbleJet Ink Cartridge *(BJ-10ex)* ..... 23.
7896 BJ-10ex Sheet Feeder ..... 75.
Cardinal ... 1 year
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2719 MB2296SR Internal Send/Receive Fax .. 109.
2721 VGA732 True Color Ultra VGA Card .... 169.
CH Products ... 1 year
7801 FlightStick w/Falcon ..... 49.
CoStar ... 1 year
1418 AddressWriter Envelope Printer ..... 499.
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9877 FasMath 83S87-16 *(SX compatible)* .... 115.
9914 FasMath 83S87-20 *(SX compatible)* .... 125.
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2358 LQ-570 *(80 col., 252 cps)* ..... 289.
2361 LQ-870 *(80 col., 330 cps)* ..... 489.
2357 LQ-1170 *(136 col., 330 cps)* ..... 669.
5184 LX-810 *(80 col., 180 cps, 9 pin)* ..... 185.

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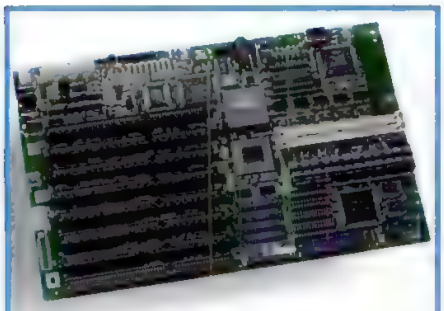

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9884 Pocket Edition 2400 ..... 129.

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1959 LaserJet Fax ..... 1399.

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6420 2400EX MNP Modem ..... 229.
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5336 Above Board Plus 8 2 MB ..... 449.
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7782 SatisFAXtion *(fax board)* ..... 399.
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1637 Snap-In 386 ..... 389.
3358 Power Pak *(Snap-In 386 & Above Board Microchannel 4 MB)* ..... 925.
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4750 80387SX *(16 MHz 80386SX CPU's)* ..... 129.
2372 80387-20 *(20 MHz 80386 CPU's)* ..... 219.
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1199 T52CC - 2 MB Upgrade for Toshiba T1000 series or T2000SX ..... 239.

Micron Technology ... 2 years
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7012 Memory Upgrade PS/2 70 - 2 MB ..... 139.

Microsoft ... lifetime
7597 Microsoft Mouse *(bus or serial)* ..... 89.
2897 Mouse with Paintbrush *(bus or serial)* ... 105.
2898 Mouse with Windows 3.0 *(bus or serial)* . 149.
1956 Mouse with Works *(bus or serial)* ..... 155.
1896 Ballpoint Mouse *(serial only)* ..... 119.

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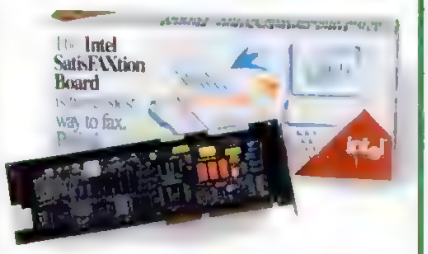
6007 *serial* ..... 75. 6008 *bus* ..... 89.
7271 *Inport* ..... 79. 6330 *PS/2* ..... 79.



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7782 *SatisFAXtion*–Send & receive faxes with the 9600 bps fax or communicate with the 2400 bps MNP modem. Fax from within most any application by way of the print command. Supports background operation & installs easily .. $399.

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5085 Multisync 3Ds Monitor ..... 619.

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7915 Turbo Cool 300 ..... 165.
7053 InnerSource 2210 *(power backup)* ..... 349.

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8975 Complete Font Library *(for LJIII)* ..... 275.
Memory upgrade for LaserJet IIP/III:
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Memory upgrade for LaserJet II/IID:
6838 *2 MB* ..... 249. 6836 *4 MB* ..... 379.
Pacific si Memory:
2252 *1 MB* ..... 99. 2253 *4 MB* ..... 319.
7158 Pacific Page PE 4.0 *(for LJ IIP/III)* ..... 379.
6834 Pacific Page *(for LJ II)* w/2 MB Mem. Brd. 379.
9833 Pacific Page XL *(w/accelerator board)* .. 799.

Panasonic ... 2 years
1410 KXP 1123 *(240 cps, 80 col.)* ..... 249.
1419 KXP 1124i *(240 cps, 80 col.)* ..... 319.
8144 KXP 1624 *(192 cps, 132 col.)* ..... 399.

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3103 2400 Baud Internal Modem ..... 129.
3102 2400 Baud External Modem ..... 179.
8993 2400 Baud Internal Modem *(V.42 bis)* .. 169.
8994 2400 Baud External Modem *(V.42 bis)* .. 209.
4542 2400 Baud Internal Modem for PS/2 ... 229.
8132 PM2400 Pocket Modem ..... 109.

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2264	PM2400FX96 *(modem/fax board)*	145.
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1305	Universal Notebook *(for ntbk. computers)*	69.
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8082	Half Page Scanner/400 w/ReadRight	289.
5828	TheComplete Communicator	319.
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9893	T2000SX Notebook *(40 MB)*	2999.
3359	T2000SX Notebook *(60 MB)*	3299.
3360	T2000SXE Notebook *(40 MB)*	3399.
3361	T2000SXE Notebook *(60 MB)*	3649.
9894	T1200XE Laptop *(40 MB)*	2099.
1779	T3100SX Laptop *(80 MB)*	3199.
1773	T3200SX Laptop *(120 MB)*	3499.
1765	T3200SXC Laptop *(120 MB)*	5899.
	Tripp Lite ... 2 years	
6199	Isobar 4-6 *(4 outlets, Gold Seal Warranty)*	49.
6200	Isobar 6-6 *(6 outlets, Gold Seal Warranty)*	59.
6201	Isobar 8-12 *(8 outlets, Gold Seal Warranty)*	69.
6018	LC1200 *(1200W line conditioner)*	159.
1528	PS6.0 *(600VA on-line UPS)*	559.
	Video 7 ... 7 years	
4931	VRAM II VGA 512k	259.
	Zoom Telephonics ... 7 years	
1307	Int. 2400 Baud w/9600 Baud Fax Modem	109.
1178	Ext. 2400 Baud w/9600 Baud Fax Modem	119.
1170	2400 Baud w/4800 Baud sendfax	69.
1181	2400 Baud V.42bis Modem *(2 year)*	159.
1167	2400 Baud Internal Modem	69.
1166	2400 Baud External Modem	85.
3075	9600 V.32 Turbo Internal Modem *(2 yr.)*	399.

Canon ... 1 year
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2339	CP30104 120 MB IDE HD *(19 ms)*	399.
1337	CP3204 200 MB IDE HD *(16 ms)*	649.
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	We are an authorized Iomega Service Center.	
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2500	PC2B Controller	199.
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	Mountain Computer ... 2 years	
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6153	DC2120 Tape Cartridge *(5 pack)*	149.
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8287	Hardcard II XL 105 MB *(9 ms)*	599.
	Seagate ... 1 year	
4554	40 MB Internal HD ST251-1 *(28 ms)*	$249.
1321	ST157A 40 Mb IDE Hard Drive	229.
1320	ST1144A 130 Mb IDE Hard Drive	475.
	TEAC ... 1 year	
4670	1.44 MB Drive for PC/XT *(3½")*	69.
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4951	720k Drive for PC/XT *(3½")*	69.
6951	1.2 MB Drive for AT *(5¼")*	75.

MEMORY

6556	256k DRAM *(100 ns, set of 9)*	call
5510	1 MB x 9 SIMMs *(80 nanosecond)*	call
2497	4 MB x 9 SIMMs *(80 nanosecond)*	call
5746	1 MB Chips *(80 ns, set of 9)*	call
7813	256k x 4 Chips	call

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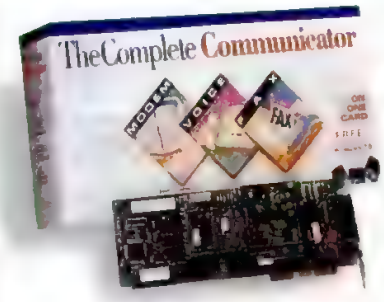

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2792	3½" DS/DD 720k Diskettes *(Qty. 10)*	13.
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	Sony ... lifetime	
3291	5¼" DS/DD 360k Disks *(Qty. 10)*	8.
3297	3½" DS/DD 720k Diskettes *(Qty. 10)*	11.
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■ CalComp ColorMaster Plus 6603PS

CalComp ColorMaster Plus 6613PS with 10MB of RAM.

The 6603PS fits images measuring up to 8.1 by 10.6 inches on standard A-size (8.5- by 11-inch) paper, thanks to its paper-feeding mechanism. A release arm facilitates loading the print medium into the supply bin. Pull the arm forward and the rubber rollers of the feed mechanism release. Push it back and they firmly grab the paper, ready to feed it smoothly into the 6603PS when printing starts.

The printer can handle up to 50 sheets of acetate or 100 sheets of treated paper. It accommodates A4- and legal-size paper. The B-size 6613PS extends the image size to 11.25 by 17.25 inches, according to the vendor.

Two trays project upward and back from the top of the machine. But the top of the rear tray does not project beyond the rear of the printer, so the only clearance you will need behind the machine is for the cables.

A single-color pass takes 22 seconds, so a four-color image will take about 90 seconds to print, not counting transfer and rastering time. CalComp uses a RISC processor to speed transfer and rasterization. But because PC Magazine Labs' test suite is not helped by a fast raster-image processor, the 6603PS delivered performance slower than most other thermal wax machines.

Color registration was excellent. The output quality compared well with other thermal wax printers, although close scrutiny of the output revealed a subtle green mottling of the three-color blacks. Still, the results were just fine for making presentations or checking prepress output.

EASY ACCESS

To access the internal mechanism of the 6603PS, you need only press a tab on the left side of the machine to open a hatch, about two-thirds the width and half the length of the printer. Push it all the way back and it latches up.

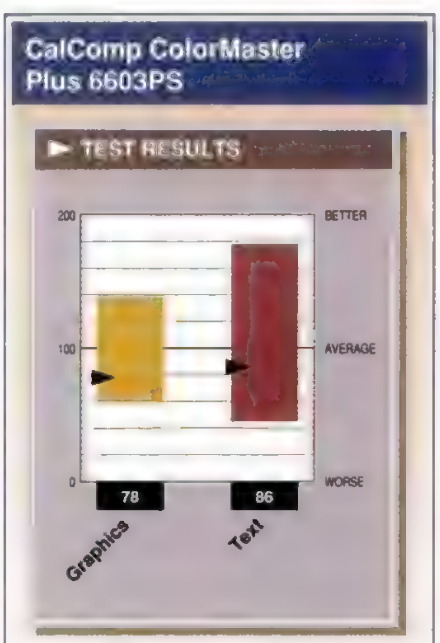
Loading transfer sheets into the 6603PS is a complex though manageable task. You must first slide the feed roller into a black anodized aluminum carrier and insert hubs in each end. Place another hub in the take-up spool, drop the supply assembly in place, stretch out the transfer sheet, and lay the take-up spool in place.

Next you advise the 6603PS whether you've installed a one-, three-, or four-color transfer sheet if it differs from the last ribbon you used. You do this by entering the appropriate values into the menu-driven control panel at the front right corner of the machine. The panel features a 16-character by 2-line LCD and six push buttons (four arranged as cursor arrows, two as Clear and Enter), which control all functions. It also monitors and displays the current printer operation.

Transfer sheets cost $90 for a one-color ribbon that produces 600 pages, $88 for three-color (210 pages), and $85 for four-color (150 pages).

The printer measures 17 by 18 by 23 inches (HWD) with its paper trays installed. While the 6603PS actually has a 17- by 18-inch footprint, CalComp recommends that you allow an additional 6 inches on the left for ventilation and several inches behind for cables to the printer's parallel, serial, AppleTalk, and SCSI ports.

The 6603PS's construction is solid, and its printhead mechanism is more rugged than most. Its competitive price does not make sacrifices in color PostScript power or the number of fonts. The 6603PS is the patriotic alternative, even if it is a bit slow.



Color PostScript scores

In Short: The $6,995 CalComp ColorMaster Plus 6603PS produces output with excellent registration and a large printable area, and it can print on B-size paper. It uses the PhoenixPage PostScript interpreter and includes 39 fonts.

FACT FILE

CalComp Inc., 2411 W. La Palma Ave., Anaheim, CA 92803; 800-225-2667.
CalComp ColorMaster Plus 6603PS
List Price: $6,995.
Standard Warranty: One year on parts and labor with on-site service from CalComp.
Dimensions (HWD): 17 x 18 x 23 inches.
Weight: 55 lbs.
Emulations: Phoenix Technologies' PhoenixPage PostScript interpreter.

CIRCLE 549 ON READER SERVICE CARD

GENERAL PARAMETRICS CORP.

*General Parametrics Spectra*Star 430*

Clear, clean fonts distinguish the General Parametrics Spectra*Star 430. The delicate weight of the system's 35 fonts and the fine serifs on the Roman typefaces make text look sharper than the 300-dot-per-inch resolution of the printer's Sharp JX-560G engine. The quality is attributable to Pipeline's PowerPage PostScript interpreter. It delivers superior quality even if you don't use the Spectra*Star 430's enhanced mode, which raises vertical resolution to 600 dpi.

At $6,995, the Spectra*Star 430 is priced squarely in the middle of the General Parametrics line. The entry-level machine is the Spectra*Star 410, with 1MB of RAM and Mitsubishi 370 emulation (but no PostScript), priced at $4,995. Other units include the $5,995 Spectra*Star 420 (with 4MB of RAM, raster mode, Mitsubishi emulation, and HPGL), the $7,995 Spectra*Star 440, which is like the 430 but with a 32MB hard disk, and the $14,990 Spectra*Star 450, which includes

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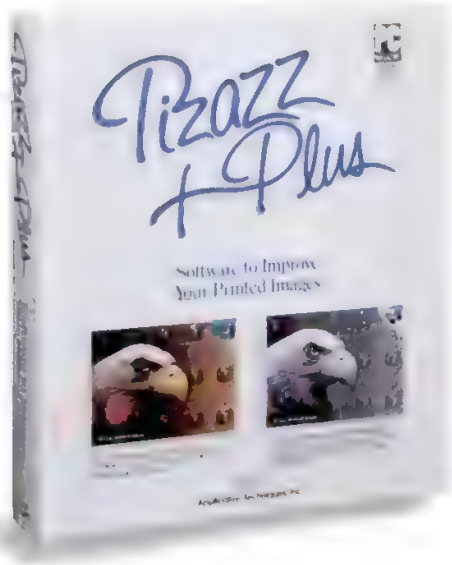

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"Pizazz Plus: Finally—An easy way to capture and print screen images" **PC World**[3]

"Pizazz Plus is an excellent screen capture program, producing high-quality output, saving files in several formats and providing the best color adjustment features of any reviewed products." **PC Week**[4]

"Pizazz...was a phenomenal product and Pizazz Plus is a lot better yet." **Computing Now**[5]

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"Pizazz Plus is a reasonably priced, useful utility for a variety of applications" **Info World**[7]

"Pizazz Plus provides the most sophisticated mapping of screen colors to black-and-white printer output." **PC Magazine**[8]

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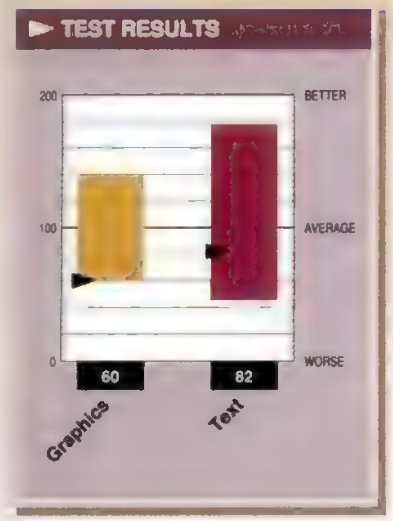
CIRCLE 330 ON READER SERVICE CARD

General Parametrics Spectra*Star 430



Color PostScript scores

In Short: The $6,995 General Parametrics Spectra*Star 430 produces beautiful images with especially elegant type, using the Pipeline PowerPage PostScript interpreter with 35 fonts. But it gives you a small printable area.

a PostScript film-making feature.

The Spectra*Star 430 combines 6MB of RAM with the Pipeline's PowerPage PostScript interpreter, HPGL, Mitsubishi 370, and a Targa-compatible raster mode. It offers parallel, serial, and AppleTalk ports, as well as a SCSI port to which you can hook up an external hard disk for storing downloadable fonts.

The Spectra*Stars are all big, square-looking printers with an 18- by 18-inch footprint. When you slide the Spectra*Star 430's paper-feed and return trays into the slots in the front of the machine, it consumes an 18- by 27-inch space and stands 13 inches high.

PLAY-BY-PLAY PRINTS

The box looks squarer than its dimensions imply, straight on all four sides and gently rounded at the corners. With its flat top, it resembles a hunkering cube, with a beveled top edge at the front to accommodate the machine's modest control panel.

Six membrane switches, including one for paper size and one for interface, and a 16- by 2-character LCD panel make up the machine's menu control system. The little LCD screen is more active than most, cycling through the printer's basic setup (paper-size and transfer-sheet type) while it sits idle. During printing, it gives a play-by-play account of what the printer is doing and even indicates the ribbon color currently in use.

The mechanism inside is solid, mostly stamped from steel, and uses two drive chains and a number of nylon gears. The Sharp engine moves paper with a large drum mechanism that removes about an inch on either end of a page from the print area. The actual printing area measures 8.1 by 8.8 inches on 8.5- by 11-inch paper and 8.1 by 10.8 inches on legal paper. The printer also supports A4 and Special A4 paper sizes.

The General Parametrics controller is based on an Intel 80960 RISC processor operating at 20 MHz. It fits inside a sturdy steel pan in the top of the case and pulls paper from a feed tray that slides into a slot at the bottom of the front panel. The tray holds 100 sheets of paper or 50 sheets of transparency film.

Transfer sheets come in loose rolls, rather than a cartridge, but these can be quickly loaded. The feed roll drops onto two open bearings; one end of the take-up spool fits a drive shaft, and the other end drops into place. The transfer sheet makes a straight pass across the top of a Kyocera printhead, which is hinged to the top of the mechanism. The printhead drops into position when you close the top of the machine.

The printer supports one-, three-, and four-color transfer sheets. The rolls are capable of making 1,000, 340, and 275 pages, respectively, and are priced at $150, $145, and $140 each.

Although the fast RISC processor in the Spectra*Star 430 should deliver top performance on vector images, on PC Labs' speed tests it failed to elicit a speedy response. In fact, the Spectra*Star 430 proved to be the slowest of all the color PostScript printers we tested. The printer has an FCC Class A rating and a 90-day warranty with on-site service.

The Spectra*Star 430's elegant fonts make for great presentations. But its best feature is its wide range of emulations, which allow you to print from nearly any software that supports color output.

FACT FILE

General Parametrics Corp., 1250 Ninth St., Berkeley, CA 94710; 800-223-0999.
General Parametrics Spectra*Star 430

General Parametrics Spectra*Star 430

List Price: $6,995; 32MB upgrade kit $1,050; film recorder and processor board, $6,995.
Standard Warranty: 90 days on parts and labor with on-site service from General Parametrics (extended warranties available).
Dimensions (HWD): 13 x 18 x 27 inches.
Weight: 70 lbs.
Emulations: HPGL, Mitsubishi G370, Pipeline PowerPage PostScript interpreter.

CIRCLE 550 ON READER SERVICE CARD

NEC TECHNOLOGIES INC.

NEC Colormate PS Model 40

Trim costs to hold down prices and something has to go. With the $6,995 NEC Colormate PS Model 40—which NEC Technologies expects to be discounted to $4,600 on the street—what's lost is memory, large paper sizes, and the 18 fonts you would expect to get with an Adobe PostScript printer.

The Model 40 is strictly for the budget-minded who can live with 17 fonts in four families (Helvetica, Helvetica Narrow, Times, and Courier), letter-size-only media, and 4MB of RAM. Those who outgrow it can trade up to its big brother, the $8,995 NEC Colormate PS Model 80, which offers 35 fonts, letter and legal paper capabilities, and 8MB of RAM.

The font and memory deficiencies of the Model 40 don't prevent it from producing high-quality output. It uses the same engine as its more expensive sibling and delivers excellent output at faster-than-average speeds. Registration is nearly perfect. Even with a three-color ribbon, blacks were truly black and solid, and the

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Performance							
Features and flexibility	(175)	Satisfactory	Good	Very Good	Excellent	Very Good	Very Good
Rescheduling/resource leveling	(100)	Satisfactory	Satisfactory	Good	Excellent	Very Good	Very Good
Speed	(75)	Satisfactory	Very Good	Excellent	Very Good	Very Good	Satisfactory
Reporting	(100)	Good	Good	Good	Very Good	Very Good	Very Good
Documentation	(75)	Very Good	Good	Very Good	Very Good	Good	Very Good
Ease of learning	(100)	Very Good	Very Good	Very Good	Very Good	Good	Very Good
Ease of use	(125)	Good	Good	Very Good	Excellent	Good	Good
Error handling	(75)	Good	Good	Satisfactory	Very Good	Good	Very Good
Support							
Support policies	(50)	Good	Good	Very Good	Good	Good	Very Good
Technical support	(50)	Very Good	Very Good	Satisfactory	Excellent	Satisfactory	Very Good
Value	(75)	Satisfactory	Good	Very Good	Excellent	Very Good	Very Good
Final scores		**6.0**	**6.4**	**7.1**	**8.7**	**6.8**	**7.1**

Source: *InfoWorld*, November 26, 1990

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CIRCLE 218 ON READER SERVICE CARD

output is Pantone-approved. The maximum image area, however, is 8.1 by 9 inches on letter-size paper; the Model 80 extends this to 8.1 by 11.9 inches for legal-size paper, according to NEC.

The case of both the Model 40 and the Model 80 is thin plastic, ribbed inside for greater rigidity. But the strength is not overwhelming. The print mechanism is built on a stamped steel foundation, screwed to the case. Most parts are metal; only the drive gears are plastic. The entire drive mechanism is connected to a heavy-duty motor that uses a thick cogged belt to run the printing process; a thin cogged belt links parts of the paper mechanism.

WRINKLED SHEETS

You access the internal mechanism by releasing a prominent latch on the printer. The top pivots upward around a hinge midway in front of a backward-leaning paper-feed tray. The tray can hold 100 pages of specially treated paper or 50 sheets of transparency medium.

Transfer rolls for the Colormates come in a cartridge that is somewhat easier to load than loose rolls. But the threading caused us problems: The transfer sheet consistently wrinkled around the optical sensor even though we followed instructions in threading the printer. (The sensor detects which color is active and whether a transfer sheet is available for it.) The wrinkling resulted in errors that were corrected only after the transfer ribbon was pulled to the right side of its cartridge, a procedure that is not outlined in the documentation.

Both the rear feed tray and the forward exit tray project back from the top of the printer at an angle of about 45 degrees. The lean-to-the-rear tray design means that you'll need about 6 inches extra behind the printer, which measures 17 by 16 by 18 inches including paper trays.

■ NEC Colormate PS Model 40

PERFORMANCE TESTS: COLOR POSTSCRIPT PRINTERS

PC LABS

The color PostScript vendors that produced the fastest printers in last December's comparison were in the lead again: QMS took home top honors for graphics speed, and NEC came in first on text speed this time around.

WHAT THE NUMBERS MEAN

Though a color PostScript printer is not generally purchased with speed in mind, print speed is an effective measure of engine efficiency. Of the nine color PostScript printers we tested, eight used a thermal wax transfer process, and one—the Tektronix Phaser III PXi—employed a solid-ink/phase-change process. Of the thermal wax transfer printers, three used four-color print ribbons (allowing for true black), whereas the remaining five printers used three-color ribbons (combining all three colors to produce black).

Based on our tests, printers using three-color ribbons are generally slower than those utilizing four-color ribbons—with less than half the output in some cases—especially in text mode, because of the three print passes required to produce black.

FASTEST ON OUR TESTS

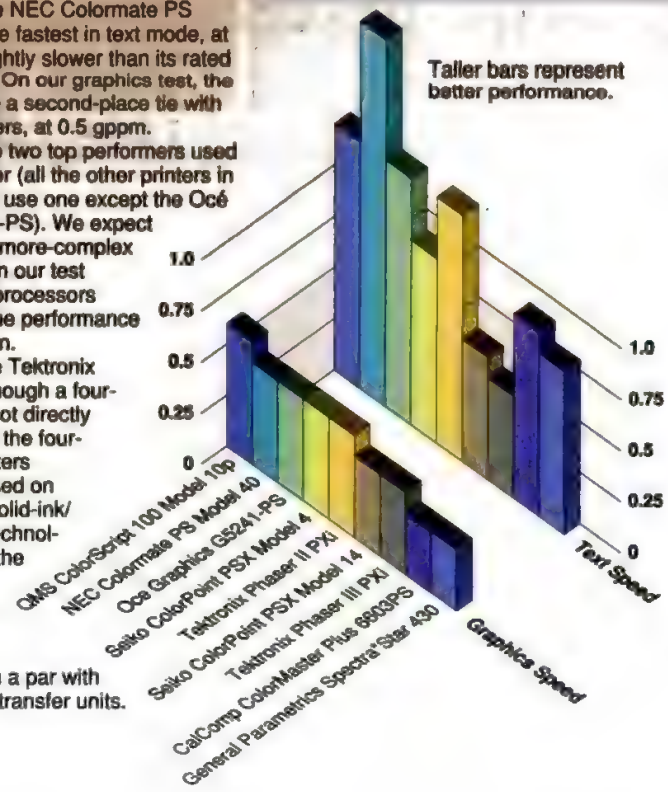
On our performance tests, the QMS ColorScript 100 Model 10p was the speediest graphics performer by a nose, at 0.6 gppm. The NEC Colormate PS Model 40 was the fastest in text mode, at 1.8 ppm, just slightly slower than its rated speed of 2 ppm. On our graphics test, the NEC emerged in a second-place tie with three other printers, at 0.5 gppm.

Neither of the two top performers used a RISC processor (all the other printers in this category did use one except the Océ Graphics G5241-PS). We expect that on larger or more-complex files than those in our test suite, the RISC processors would improve the performance of the competition.

Note that the Tektronix Phaser III PXi, though a four-color printer, is not directly comparable with the four-color ribbon printers because it is based on slightly slower, solid-ink/phase-change technology. It turned in the slowest text speed of the lot, at 0.5 ppm; its graphics speed, however, was on a par with the thermal wax transfer units.

The **Text Speed** test measures the time it takes to send and print ten copies of a two-page business letter with 1-inch margins in 10-cpi type. Results are reported in pages per minute.

The **Graphics Speed** test measures the time it takes to send and print two copies of a graphics image created using *PageMaker* and *Microsoft Windows*. Results are reported in graphics pages per minute.



Paper is pulled down from the rear tray, spun around a drum, and drawn past the thermal printhead. It pokes into the exit tray with every pass until it finally slides out. The exit tray is covered with a textured, smoked-plastic cover; conductive carbon fibers hang from the far side of the cover to dissipate static that could disrupt proper paper travel.

The control panel of the Model 40 is inset in the front of the machine and features a 16-character LCD, five membrane switches, a thumbwheel, and two LEDs on the front edge of the machine. Although the thumbwheel allows you to adjust the density of print, the documentation and printed output both favor the use of a single setting.

The membrane switches and LCD make up a menu system for setting up the various features of the printer. Using a combination of the Menu, Next, and Select keys, you can select the interface used (both Colormates are equipped with parallel, serial, AppleTalk, and SCSI interfaces), along with paper size and other functions. A membrane switch brings the printer on-line.

The NEC Colormate PS Model 40 offers a low-cost entry into color PostScript printing, one that later can be upgraded to what you should have purchased in the first place. Its strength is that most budgets that can't afford the higher-priced models can manage this one now.

FACT FILE

NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; 800-632-4636.
NEC Colormate PS Model 40
List Price: $6,995.
Standard Warranty: One year on parts and labor with 90 days on-site service from NEC.
Dimensions (HWD): 17 x 16 x 18 inches.
Weight: 55 lbs.
Emulations: Adobe PostScript.

CIRCLE 601 ON READER SERVICE CARD

OCÉ GRAPHICS USA INC.

Océ Graphics G5241-PS

One's reaction to Euro-styling is mostly a matter of taste, but the French-designed Océ Graphics G5241-PS will appeal even to those who are cool to its curves. More than a face that is exceptionally pretty (or just different), the Océ Graphics design is functional. It offers easy and convenient access to the vital innards of this $8,990 thermal wax printer, which Océ Graphics expects to sell for $6,500 to $7,000.

Océ ("oh-say") Graphics, which also makes pen and thermal plotters, is based in France. The parent company is Dutch and was part of the Schlumberger conglomerate until two years ago.

Equipped with true Adobe PostScript, the Océ Graphics G5241-PS delivers faster-than-average performance with excellent color output. It comes equipped with 35 fonts, delivers 300-dot-per-inch resolution, and requires about 1 minute to print a page. Its 8MB of RAM is not upgradable.

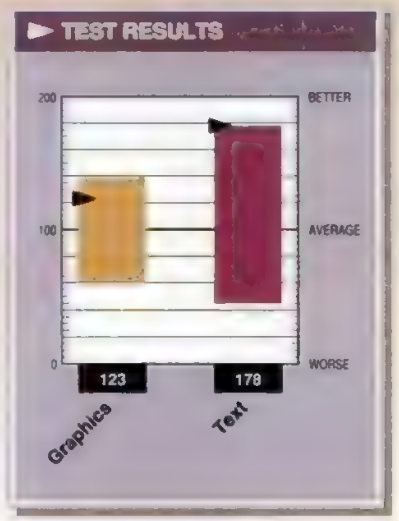
The G5241-PS handles only A (letter-size) and A-long (8.5- by 12.7-inch) paper. But it will deliver a full-size print area if you opt for A-long and trim off the extra margin. Three larger models take sheets up to 11.7 by 17.1 inches and cost $10,990 with 8MB of RAM, $12,990 with 12MB, and $15,990 with 16MB.

Despite its unusual styling, the G5241-PS's measurements are rather ordinary—a 16- by 17-inch footprint and an overall size of 10 by 16 by 24 inches when you include the paper tray. But it looks much more compact. The plastic curl on top holds the ink transfer sheets.

To load ink sheets, pop an access hatch and drop the source and take-up rolls into place over a straight, unobstructed threading path. In our unit, however, the cardboard-tube take-up rolls proved to be a bit too long to easily fit between their hubs. The problem was solved by the brute force method. A single four-color transfer roll can produce 80 pages; three-color produces 100, and monochrome produces 300 pages. All rolls cost $49 each.

Little of the Shinko 445 engine used by the G5241-PS is visible when you pop open the access hatch. Most is covered by the printer's protective plastic shell. The Kyocera printhead, which rides on the hatch cover, is hinged to the rest of the mechanism. A riveted stamped-steel chassis fits inside the machine's decorative plastic case. The rubber platen allows a moderately large active printing area: 8.2 by 9.3 inches on letter-size paper, 8.2 by 11 inches on A-long paper.

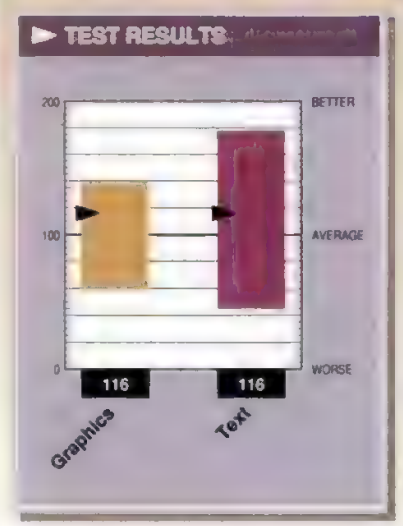
NEC Colormate PS Model 40



Color PostScript scores

In Short: The $6,995 NEC Colormate PS Model 40 includes Adobe PostScript but skimps on fonts, including only 17. It offers a small printable area, but its output quality is just as good as its competitors'. On PC Labs' test, the Colormate delivered the fastest text speed in this category.

Océ Graphics G5241-PS



Color PostScript scores

In Short: Notable for its physical styling, the Océ Graphics G5241-PS produces quality output, using Adobe PostScript with 35 fonts, but that output has a small printable area. And at $8,990, the printer is a little on the pricey side.

Phaser and TekColor are trademarks of Tektronix, Inc. for color printers and related products. PostScript is a trademark of Adobe Systems Inc. registered which is registered in the USA and other countries. Other marks are trademarks or registered trademarks of the manufacturers or marketers of the products with which the marks are associated.

Not only is the Phaser™ II PXi the first thermal wax printer with Adobe's PostScript© Language Level 2 software, it also has HP-GL. What more could you want from a printer?

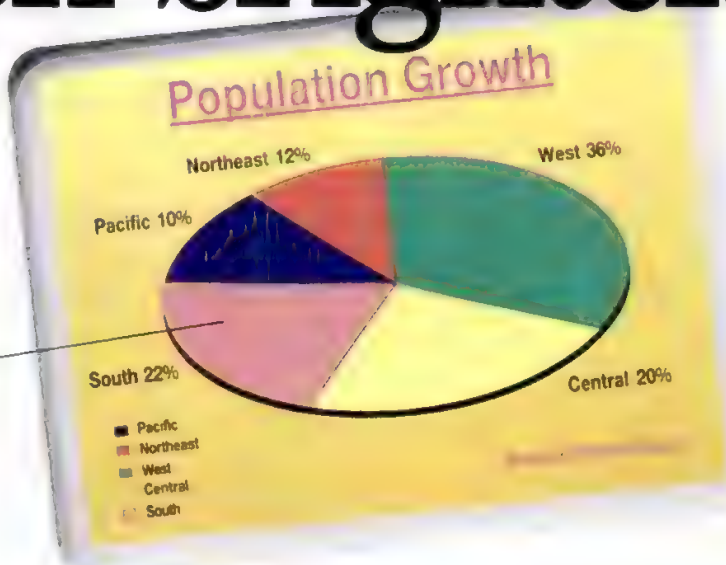
Now make your id

The Phaser II PXi was designed with shareability in mind. So it works with Macs, PCs and workstations simultaneously.

A screaming 24 MHz RISC processor and 6 Mb of memory make the Phaser II PXi the fastest color printer on the market. Really.

The Phaser II PXi delivers 16.7 million brilliant colors at 300 dpi. If you don't believe us, count them for yourself.

eas even brighter.



You say you want superior color fidelity? Rest assured the Phaser II PXi is approved by Pantone and features TekColor™ matching.

So you have this great idea. One that'll win an account. Break a sales record. Or simply make you look like a genius. Don't blow it with a color printer that won't do your brainwork justice.

Get the new Phaser II PXi, the thermal wax printer that's flexible, cost-effective (at just $7995), and able to produce millions of brilliant colors.

See the quality of its output for yourself. Just call 1-800-835-6100, Dept. 15E and we'll send you a free sample

The new Phaser II PXi. It'll make your ideas look as bright as they ought to.

Tektronix.
The best and the brightest.

CIRCLE 477 ON READER SERVICE CARD

■ Océ Graphics G5241-PS

The paper tray fits into a slot midway up the front of the machine and holds up to 100 sheets of specially treated paper or 50 sheets of transparency media. The output tray has only half the capacity.

The control panel has eight push buttons and a 16-character LCD of the machine's menuing system. From the menu, you select the interface (parallel, serial, or AppleTalk), printing parameters, and language of the prompts on the LCD. A SCSI port allows you to connect a hard disk for storing downloadable fonts. The Océ controller is based on a Motorola 68020 processor operating at 16.67 MHz.

Convenience is compromised in one area. You must explicitly set the type of transfer sheet you're using (one-, three-, or four-color). Many other thermal wax machines automatically detect that information. If you specify the wrong type, the G5241-PS is apt to print oddly colored images. When you see them, you'll know immediately what is wrong, but you'll have wasted a transfer sheet.

The only short side of the Océ Graphics G5241-PS is the small paper it handles. This is a competent, distinctively styled printer that should serve prepress and presentation jobs well.

COLOR POSTSCRIPT PRINTERS: SUMMARY OF FEATURES

Products listed in alphabetical order

	CalComp ColorMaster Plus 6603PS	General Parametics Spectra*Star 430	NEC Colormate PS Model 40	Océ Graphics G5241-PS	QMS ColorScript 100 Model 10p	Seiko ColorPoint PSX Model 4
List price (tested configuration)	$6,995	$6,995	$6,995	$8,990	$6,995	$9,499
PHYSICAL CHARACTERISTICS						
Dimensions (HWD, in inches)	17 x 18 x 23	13 x 18 x 27	17 x 16 x 18	10 x 16 x 24	12 x 17 x 22	8 x 14 x 25
Weight (pounds)	55	70	55	42	65	41
ENGINE						
Engine type	Thermal wax transfer	Thermal wax transfer	Thermal wax transfer	Thermal wax transfer	Thermal wax transfer	Thermal wax transfer
Model	CalComp 6603	Sharp JX-560G	NEC Colormate	Shinko 445	Mitsubishi G370	Seiko CH5504-DX10
Memory (tested configuration)	6MB	6MB	4MB	6MB	4MB	10MB
Maximum resolution (horizontal by vertical dots per inch)	300 x 300	300 x 300	300 x 300	300 x 300	300 x 300	300 x 300
Controller with RISC processor	Intel 80960	Intel 80960	None	None	None	Intel 80960
Average cost per page (four-color)	$0.68	$0.56	$0.65	$0.70	$0.58	$0.59
INTERFACES						
Parallel	■	■	■	■	■	■
Serial	■	■	■	■	■	■
AppleTalk	■	■	■	■	■	■
SCSI port	■	❑	■	■	■	❑
Automatic interface switching	■	■	❑	❑	❑	■
Simultaneously active ports	■	■	❑	❑	❑	■
PAPER HANDLING						
Accepts plain paper	❑	❑	❑	❑	❑	❑
Paper capacity (sheets)	100	100	100	100	100	145
Letter-size paper (8.5 x 11 inches)	■	■	■	■	■	■
Size of printable area (inches)	8.1 x 10.6	8.1 x 8.8	8.1 x 9	8.2 x 9.3	8.1 x 9	8.2 x 10.7
Legal-size paper (8.5 x 14 inches)	■	■	❑	❑	❑	❑
Size of printable area (inches)	8.1 x 10.6	8.1 x 10.8	N/A	N/A	N/A	N/A
B-size paper (11 x 17 inches)	■	❑	❑	❑	❑	❑
Size of printable area (inches)	10.6 x 16.6	N/A	N/A	N/A	N/A	N/A
Duplexing	❑	❑	❑	❑	❑	❑
Rated maximum paper weight (pounds)	24	13.5	24	24	Info not available	22
FONTS AND FEATURES						
PostScript language support	PhoenixPage	Pipeline	Adobe	Adobe	Adobe	PhoenixPage
Supports Type 1 fonts	■	■	■	■	■	■

—Editors' Choice ■—Yes ❑—No

N/A—Not applicable: The product does not have this feature.

FACT FILE

Océ Graphics USA Inc., 385 Ravendale Dr., P.O. Box 7169, Mountain View, CA 94039-7169; 800-545-5445.
Océ Graphics G5241-PS
List Price: $8,990.
Standard Warranty: 90 days on parts and labor with on-site service from Océ or express exchange.
Dimensions (HWD): 10 x 16 x 24 inches.
Weight: 42 lbs.
Emulations: Adobe PostScript.

CIRCLE 602 ON READER SERVICE CARD

Seiko ColorPoint PSX Model 14	Tektronix Phaser II PXi	Tektronix Phaser III PXi
$12,999	$7,995	$9,995
8 x 18 x 31 47	15 x 17 x 27 73	13 x 28 x 35 90
Thermal wax transfer Seiko CH5514-RX18 18MB 300 x 300	Thermal wax transfer Sharp 4694 6MB 300 x 300	Solid ink Tektronix 4698 10MB 300 x 300
Intel 80960 $0.62	AMD 29000 $0.56	AMD 29000 $0.25
■ ■ ■ □ ■ ■	■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■
□ 80 ■ 8.2 x 10.7 □ N/A	□ 100 ■ 8.1 x 8.8 ■ 8.1 x 11.6	■ 200 ■ 8 x 10.5 ■ 8 x 13.5
■ 10.8 x 16 □ 22	□ N/A □ 20	■ 10.5 x 16.5 ■ 120
PhoenixPage ■	Adobe Level 2 ■	Adobe Level 2 ■

printers COLOR POSTSCRIPT

QMS INC.

QMS ColorScript 100 Model 10p

Entry-level for QMS means short sheets and slim memory, but full Adobe PostScript support with 35 fonts. That is what you get with the QMS ColorScript 100 Model 10p.

This big block of a machine, with its $6,995 list price, holds up the bottom of the company's line of thermal wax printers. And QMS estimates that the unit sells for an intriguingly affordable $4,900 on the street. On the downside, however, the Model 10p skimps on print area, using only 8.1 by 9 inches of an A-size sheet. And it cannot be upgraded to the specifications of its older though more robust and expensive cousin, the $8,995 Model 10, which puts larger images on legal-size paper.

Still, the Model 10p proved to be the fastest of all Color PostScript printers we tested. And its speed does not compromise its 300-dot-per-inch resolution quality. The Model 10p is Pantone-certified, but it offers a choice of lower-priced inks for presentations or more-expensive inks for Pantone color-matching prepress work.

In our testing, the output of the Model 10p proved to be very good, with smooth, even colors. Contrast, however, was higher than from other thermal wax printers, with the exception of the NEC Colormate PS Model 40; the Model 10p's high contrast posterized gray samples and blocked up the shadows in the graphics image. Text quality was good.

Although its squared-off case design gives it a bulky appearance, the Model 10p is actually about average size for a thermal wax printer. It occupies a 17- by 16-inch footprint and a 12- by 17- by 22-inch volume if you include its front-mounted paper trays.

The Model 10p's control panel is a simple arrangement of indicator LEDs and four membrane switches. The controls are plain but sufficient. Separate LEDs illuminate to indicate five error conditions (paper out, ink out, paper jam, cover open, and excess heat), paper-tray size (letter and A4 only, with no distinction between letter and legal), ink sheet type (one-, three-, or four-color, selected automatically), media (paper or transparency), communications port, and speed.

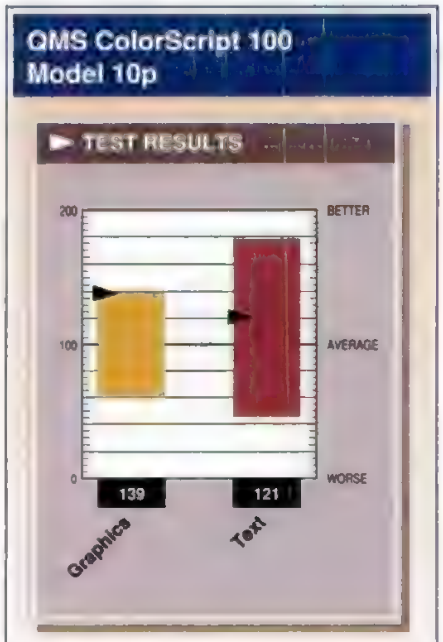
HMMMMM. . .CHUNK

The basic print mechanism is a Mitsubishi G370 engine, which is made from heavy aluminum casting. A rubber roller system moves the media. The printhead, made by Kyocera, is spring-loaded in the hinged case cover. When you close the lid, a motor latches onto the printhead and pulls it down to the proper printing position. A cooling fan is perched directly above the printhead. The whole mechanism is cleanly laid out, with all of its plastic gears tucked under the protective plastic molding of the case.

In operation, the Model 10p is not exactly what you would call loud, but it does exude an odd hum as it cycles media through its mechanism, and it chunks when it changes direction.

The QMS controller is based on a Motorola 68020 processor running at 16.67 MHz. Four interfaces to it are standard: parallel, serial, AppleTalk, and SCSI.

QMS includes a ribbon cassette that makes loading transfer rolls more convenient. Their installation is a simple, almost drop-in process: Lay the rolls in



Color PostScript scores

In Short: The $6,995 QMS ColorScript 100 Model 10p uses Adobe PostScript with 35 fonts. It produces high-quality output but only a small printable area. On PC Labs' test, the Model 10p delivered the fastest graphics speed in this category.

This is a giant step in

Always a Step Ahead.™

In a recent article, *PC Computing* named only one computer "the ultimate PC."

The Everex™ STEP™ Megacube.™ "Working with the Megacube is sheer joy...It gives me everything I'm looking for," said the reviewer.* Such unequivocal praise is no overstatement. Because with the STEP Megacube, Everex has achieved not one design breakthrough — but several.

A BIG STEP FORWARD LEAVES OTHERS BEHIND.

The powerful combination of Intel's hot i486™/33 CPU chip and Everex's proprietary Advanced Memory Management Architecture (AMMA™), a second level cache of up to 256K, makes for a warp speed of 20.8 MIPS.**

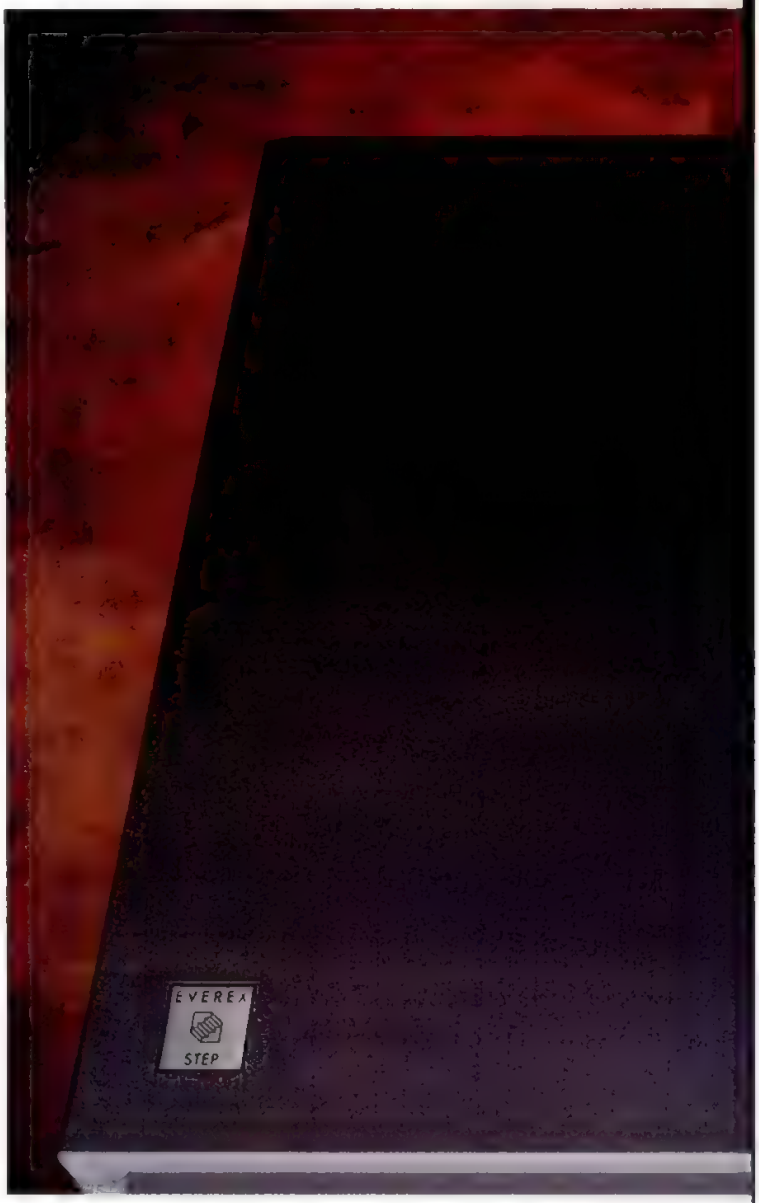
And with 12 expansion slots, 8 drive bays, a 400-Watt power supply, and up to 64MB of memory–enough for even the most demanding applications–the STEP Megacube has more expansion capabilities than any computer on the market today.

intel inside

THE ULTIMATE PC IS THE IDEAL FILE SERVER.

Everex has designed a powerful network server specifically to meet the requests of network and multiuser system administrators like yourself. Not only do you want a topnotch server that's expandable and performs well, but you also want reliability and serviceability.

In the STEP Megacube, you'll find everything you asked for and more. For example, recognizing that security is all-important on a network,

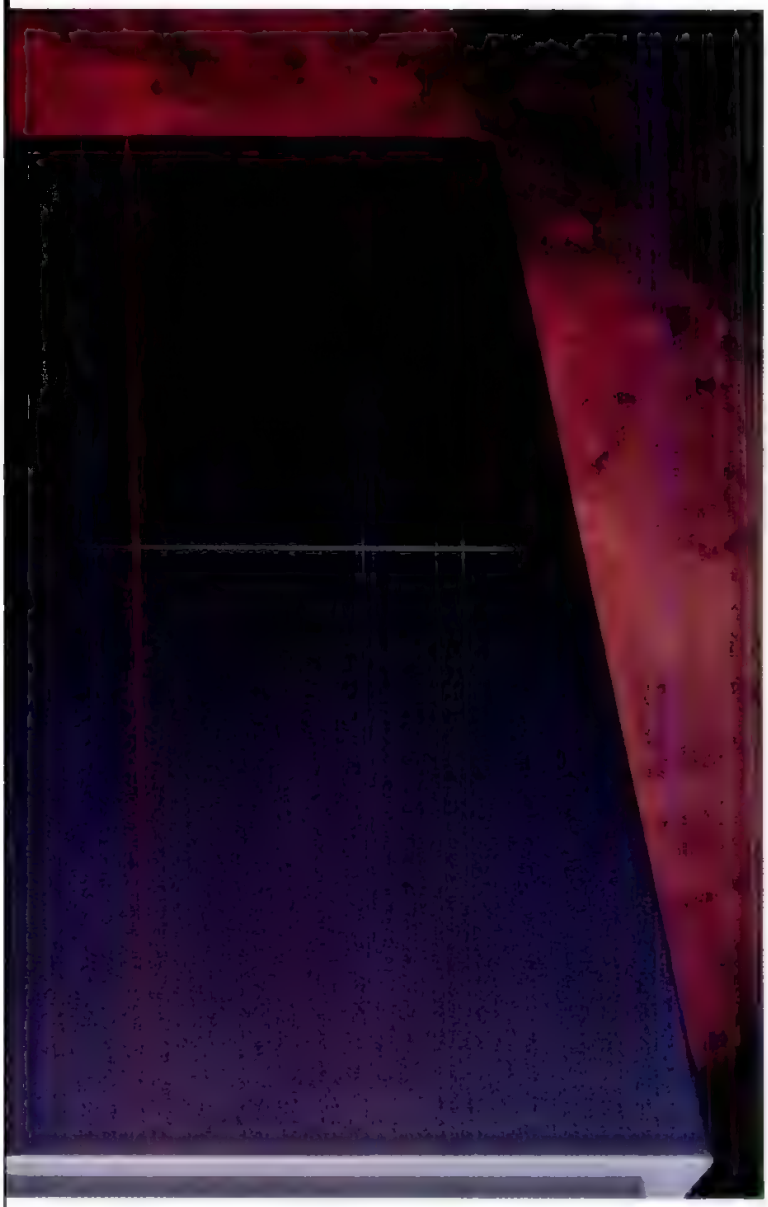


The STEP MegaCube is the first system to incorporate advanced thermal management to prevent problems caused by overheating. The Everex Thermal Management

STEP MEGACUBE 486/33

- 20.8 MIPS
- 486/33 Microprocessor
- 8 Half-height drive bays
- Up to 64MB of RAM
- 256K Cache
- 10 of the expansion slots are EISA
- 400 Watt power supply
- Everex Thermal Management System (ETMS)
- Side panels and drive bays mounted with thumbscrews
- Chassis locks
- Password protection
- Upgradeable to future-generation motherboards

personal computing.



System (ETMS™) maintains lower internal temperatures, and a dual compartmental design separates the microprocessor and disk drives, the hottest system components.

Everex has built in password protection to ensure that data remain safe from unauthorized users. And the STEP Megacube is even available preconfigured for Novell® Netware.

A COMPANY THAT'S ALWAYS A STEP AHEAD.

But file serving is not all the Megacube was designed for. On the contrary, this multifaceted computer performs equally well as a graphics workstation and multiuser system. You won't find a more versatile system anywhere, nor one with so many design firsts.

Megacube design innovations include everything from a distinctive cube design to a unique thermal management system that eliminates reliability problems caused by the heat from high-performance systems. And don't forget the remarkably low base price of $4,559.***

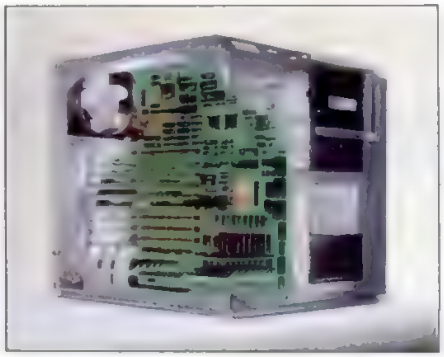
But this should come as little surprise to anyone familiar with Everex and our wide range of quality computer products. At Everex, our mandate is "Always innovate, never compromise."

TAKE A GIANT STEP.

To find out more, call 1-800-258-STEP or mail the reply card.

It's certainly a STEP in the right direction.

The entire interior of the cube is accessible in seconds through sidepanels, using thumbscrews. So it can be easily serviced without being moved, and without removing devices stacked on top of it. Everex has designed a special hydraulically-dampened door to keep dust and contaminants out of components that are accessible from the front of the system.



EVEREX
EVER for EXcellence®

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CIRCLE 113 ON READER SERVICE CARD

And here are se
same d

STEP 386SX/16
- 3.5 MIPS*
- 1-16MB RAM
- Starting at $1,499**

STEP 386SX/20
- 4.6 MIPS
- 1-16MB RAM
- Starting at $1,599

STEP 386/25
- 8.1 MIPS
- 1-64MB RAM
- Starting at $2,049

STEP 386/33
- 10.4 MIPS
- 1-64MB RAM
- Starting at $2,499

EVEREX STEP
Always a Step Ahead.™

The STEP Megacube isn't the only Everex STEP™ computer that outruns the competition. Any STEP you take gives you the best combination of price, performance and innovative engineering available in the PC industry.

Key to the STEP's blazing speed is Everex's proprietary Advanced Memory Management Architecture (AMMA), a second level cache of up to 256K.

SEVERAL STEPS THAT LEAVE OTHERS BEHIND.

The STEP line offers Everex's proprietary Advanced Memory Management Architecture (AMMA™), a second level cache of up to 256K. That increases cache hit rates to as high as 99%—maximizing overall performance.

And like the Megacube, the entire STEP line is expandable. Each computer has 8 or more expansion slots. And up to 64MB of RAM (up to 16MB in the STEP 386™SX).

What's more, with an IN STEP direct CPU replacement board, all 386DX STEP computers are easily upgradeable to i486 systems.

STEP's LED display provides detailed status

With every STEP computer, the following items are included free:

	Suggested Retail Value
FREE Windows™	$145
FREE Mouse	$80
FREE MS-DOS™ 5.0	$130
FREE 1-year parts and labor warranty	NC
FREE 1-year on-site service†	$250
	$605

†*on-site service also covers all Everex peripherals in the computer system*

veral steps in the irection.

STEP 486SX/20
- 13 MIPS
- 1-64MB RAM
- Starting at $2,999

STEP 486/25
- 16.2 MIPS
- 4-64MB RAM
- Starting at $4,699

STEP 486/33
- 21.7 MIPS
- 4-64MB RAM
- Starting at $4,799

STEP 486/33 EISA
- 20.8 MIPS
- 4-64MB RAM
- Starting at $5,799

and error messages in English—not code. So problems can be identified and remedied faster, resulting in less downtime.

Everex has also added Programmable Configuration Select, so no diskettes or jumpers are needed for setup. And Programmable Drive Tables allow virtually any drive to be installed and used to its fullest capacity.

Should you ever need service, it's comforting to know that every STEP computer is backed by one-year warranties for on-site service and for parts and labor. (A three-year parts and labor warranty is also available.) Knowing Everex, you'd expect nothing less. After all, we insist on quality and reliability in every computer product we sell. In fact, Dataquest*** recently rated Everex number one in customer satisfaction.

Detailed status and error messages appear on the STEP's LED display in English—not in computer code—so troubleshooting time is shortened.

intel inside

TAKE YOUR NEXT STEP.

Call 1-800-258-STEP to find out more about the STEP line or mail the reply card. You'll soon discover how far a STEP can take you.

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EVER for EXcellence®

*MIPS Source: Intelligent Devices' High Test Benchmarking Software. **All prices are suggested retail. Actual prices may vary. ***Dataquest PC Customer Satisfaction Study 1990. International Operations: Canada 800-661-2003, France 33 1 69 07 60 41, Hong Kong 852 389 2365, Spain 341 430 9212, U.K. 44 81 205 0607. EVER for EXcellence is a registered trademark, and Everex, STEP, Megacube, AMMA and Always a Step Ahead are trademarks of Everex Systems. 386, i486 and the Intel Inside Logo are trademarks of Intel Corporation. MS-DOS and Windows are trademarks of Microsoft Corporation. © 1991, Everex Systems, Inc.

CIRCLE 107 ON READER SERVICE CARD

• QMS ColorScript 100 Model 10p

the cassette, snap it closed, and drop it into the machine. A release lever clamps the drive against the ends of the rolls when the cassette is properly in place.

Transfer rolls for the Model 10p are sold in units of two and will cost you $105 for the pair. Monochrome presentation-quality sheets make a total of 300 pages; three-color, 120 pages; and four-color, 100 pages. Pantone sheets have less capacity: 100 pages in three-color, 85 sheets in four-color.

The input paper tray, which holds 100 sheets of treated paper or 50 transparencies, slides into a slot at the bottom front of the Model 10p. A two-layer receiving tray fits on top. As you print, the partially printed sheets slide temporarily into a protected middle layer of the output tray. When the job is complete, the Model 10p ejects the fully printed pages so that they slide out on top, face up.

The QMS ColorScript 100 Model 10p is protected by the manufacturer's one-year return-to-factory warranty. It gives acceptable, low-cost entry into color PostScript printing—at least if you don't need images more than 9 inches long.

FACT FILE

QMS Inc., One Magnum Pass, Mobile, AL 36618; 800-631-2692; 205-633-4300.

QMS ColorScript 100 Model 10p

List Price: $6,995; AFPlink controller, $2,495; package of two transfer rolls, $105; 20MB hard disk, $995; 40MB hard disk, $1,495.

Standard Warranty: One year on parts and labor with return-to-depot service from QMS.

Dimensions (HWD): 12 x 17 x 22 inches.

Weight: 65 lbs.

Emulations: Adobe PostScript.

CIRCLE 603 ON READER SERVICE CARD

SEIKO INSTRUMENTS USA INC.

Seiko ColorPoint PSX Model 4

Seiko ColorPoint PSX Model 14

Wall-to-wall color is what Seiko Instruments promises from its ColorPoint PSX Models 4 and 14. Seiko pushes the ColorPoints' image area nearly to the edge of the paper, thanks to its novel trim-as-you-print plan.

In addition, the Seiko sisters give you all the features you would expect from a color PostScript printer, starting with 300-dot-per-inch resolution. They use Phoenix Technologies' PhoenixPage PostScript interpreter. The $9,499 Model 4 comes with 10MB of RAM. Upline versions of the PSX Model 4 are available with 18MB, 22MB, and 34MB for $10,600, $11,249, and $13,099, respectively. The $12,999 PSX Model 14, with 18MB of RAM, also can be had in more-robust versions—with 22MB of RAM for $13,599 or 34MB for $15,399. Seiko also sells the printers with a slower processor (16 MHz instead of 25 MHz): The 16-MHz PS Model 4 is $6,999 with 6MB, and the 16-MHz PS Model 14 $9,999 with 10MB. Since these machines had just been introduced at the time of this writing, street prices were impossible to determine. All of the ColorPoints feature 39 fonts and PostScript compatibility through the use of Phoenix Technologies' PhoenixPage interpreter.

The chief difference between the Model 4 and Model 14 is the size of paper each can handle. The Model 4 accepts paper that is nominally 8.5 inches wide; the Model 14 accepts 11-inch-wide paper. The Model 4 is a smaller machine, requiring a desk space of only 14 by 18 inches, and occupying a volume of 8 by 14 by 25 inches once the paper output tray is installed. The Model 14 stomps out a footprint 18 inches square and occupies a volume of 8 by 18 by 31 inches when its paper tray is fully extended.

Paper lengths and input trays are irrelevant on the ColorPoints; they all use media rolls instead of individual sheets. Consequently, the only paper tray that adorns the printers is the exit tray. Built into each printer is a paper cutter that slices off individual sheets of the appropriate length, depending on the print format and roll width you choose. The Model 4 allows three different sizes: A (letter size, 8.5 by 11 inches), A4 (8.3 by 11.7 inches), and A Super (8.8 by 15 inches). The Model 14 will shoot out sheets of size A, A3 (11.7 by 16.5 inches), A4, B (11 by 17 inches), B4 (10.1 by 14.3 inches), and B Super (12 by 19.1 inches).

The roll-feed printing scheme has one big advantage. An extra 1.75 inches of paper—about the length that's needed to grab the paper and run it through the mechanism—is trimmed off and expelled in the cutting process. This leaves you with an extra strip of paper to dispose of as each page emerges. But it makes the ColorPoints able to fill a normal-size sheet of paper better than any other thermal wax printer we reviewed. The image extends to within 0.2 inch of the edge on all sides of the paper (except on A3 and B Super sizes). The largest image on a sheet of letter size (after cutting) measures 8.2 by 10.7 inches.

• Seiko ColorPoint PSX Model 4

• Seiko ColorPoint PSX Model 14

ROLLING PAPER

There is a downside to the rolling paper supply, however. The printer's transfer sheets install above it, and the arrangement complicates matters when you want to change from paper to transparency media. You have to remove the ribbon to change media.

Loading paper and transfer sheets requires some prestidigitation. You must first mount three spools (paper supply,

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PC MAGAZINE

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PC MAGAZINE *Service and Reliability Survey, September 25, 1990*

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PC MAGAZINE *Bill Machrone, Editor–in–Chief, September 11, 1990*

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COMPUTER SHOPPER *October 1990*

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PC Sources *November 1990*

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PC Sources *August 1991*

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transfer sheet supply, and transfer sheet take-up) on drive shafts, then open the printer by releasing a latch on the right side. The top pivots up like a clamshell to allow you to place the completed assemblies in the printer, paper first. You load the transfer sheet rolls (mercifully, along an unobstructed straight path) after you push the leading edge of the paper through the mechanism. The process is not difficult the second time through, but it still requires more work than with other thermal wax printers.

Transfer ribbons and paper rolls are sold in boxes of four, which must be ordered directly from Seiko. For the Model 4, a box of four one-color ribbons, sufficient for printing 600 pages each, costs $280; three-color ribbons, which produce 176 pages each, cost $294 a box; four-color sheets, which produce 123 pages each, cost $257 a box. For the Model 14, a four-roll box of one-color ribbons (150 pages each) costs $485, four three-color rolls (123 pages each) cost $350, and four four-color rolls (107 pages each) cost $345. A-size paper rolls cost $40 for a box of four, and B-size rolls cost $42 per box of four. Shipping is included in the price.

The ColorPoints use Kyocera printheads, which are fan-cooled and mounted on a heavy-duty aluminum casting, which is spring-loaded against the top of the case.

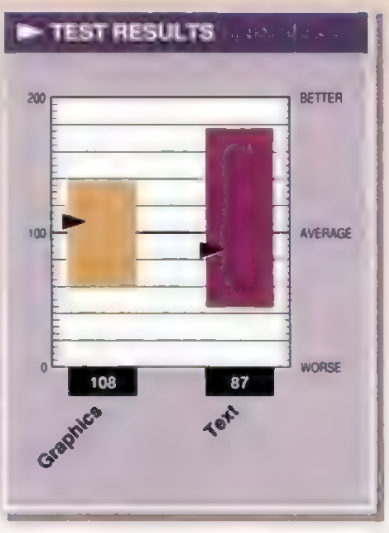
These machines represent the third generation of Seiko thermal wax printers; the first was introduced in 1982. Though the ColorPoints have different on-board BIOSes to handle their different paper sizes, both use the PSX controller, which is based on an Intel 80960 RISC processor operating at 25 MHz. It can handle up to 34MB of RAM in the form of standard Mac II 8-bit SIMMs. You can buy these on the open market or order them from Seiko at $150 per megabyte.

Both ColorPoints have a calculator-style control panel with 22 slightly raised push buttons, including a full numeric keypad, cursor keys, an Enter key, and several special function keys to operate a menu of important functions. Five LEDs and a 16-character LCD readout complete the control panel.

The ColorPoints' output had the lowest contrast and thus the widest tonal range of all the color PostScript printers we tested. This lent extra detail to halftone renderings. The registration was excellent. And although the output speed on PC Magazine Labs' graphics speed test was slightly below average, this was hardly enough of a difference to worry about.

Choose either of the pair for their large printable areas and excellent quality. But you will pay extra, in both convenience and price, for what you get from the Seiko ColorPoint PSXs.

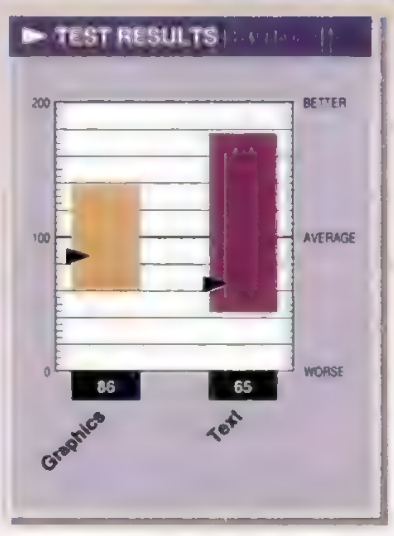
Seiko ColorPoint PSX Model 4



Color PostScript scores

In Short: At $9,499, the Seiko ColorPoint PSX Model 4 is expensive, but it sports a novel narrow carriage that uses roll-fed paper to extend the printable area over nearly a whole sheet. It uses the PhoenixPage PostScript interpreter with 39 fonts. The Seiko printers delivered the widest tonal range of all the color PostScript printers we tested.

Seiko ColorPoint PSX Model 14



Color PostScript scores

In Short: The Seiko ColorPoint PSX Model 14 differs from the Model 4 only in that it uses a wide carriage (for B-size paper) and has more memory (18MB compared with 10MB). At $12,999, it is the most expensive printer in this category.

FACT FILE

Seiko Instruments USA Inc., 1130 Ringwood Ct., San Jose, CA 95131; 408-922-5800.

Seiko ColorPoint PSX Model 4
List Price: $9,499; 4MB upgrades, $600 each.
Standard Warranty: One year on parts and labor with on-site service from Seiko.
Dimensions (HWD): 8 x 14 x 25 inches.
Weight: 41 lbs.
Emulations: Phoenix Technologies' PhoenixPage PostScript interpreter, HPGL.

Seiko ColorPoint PSX Model 14
List Price: $12,999; 4MB upgrades, $600 each.
Standard Warranty: One year on parts and labor with on-site service from Seiko.
Dimensions (HWD): 8 x 18 x 31 inches.
Weight: 47 lbs.
Emulations: Phoenix Technologies' PhoenixPage PostScript interpreter, HPGL.

CIRCLE 604 ON READER SERVICE CARD

TEKTRONIX INC.

Tektronix Phaser II PXi

Tektronix Phaser III PXi

Until now, the terms *color PostScript* and *thermal wax* have been nearly interchangeable. The Tektronix Phaser III PXi aims to change all that.

The Phaser III PXi takes a new approach to solid-ink printing with a technology Tektronix calls "phase change." And it features a high-performance controller, yielding the first plain-paper color PostScript printer and the top of the Tektronix line. The Phaser III PXi is priced

DYE DIFFUSION PRINTERS: The High Price of Photo-realism

Dye diffusion printers are twice as expensive as thermal wax transfer or solid-ink color printers. They fall outside the mainstream, especially because most of them lack a standard PC printer emulation, such as PostScript. But one look at the photo-realistic quality of their color output and you may be tempted anyway.

by James Karney

Dye diffusion thermal transfer (D^2T^2) printers—also known as dye sublimation or continuous-tone printers—are in a class by themselves, allowing users to create full-color prints that rival photographs. Twice as expensive as the color PostScript printers reviewed here, they are not for the mainstream business user. D^2T^2 printers range from about $13,500 to $25,000 for basic units and go as high as $40,000; by contrast, Color PostScript printers range from roughly $7,000 to $13,000.

And because they lack such standard PC printer languages as PostScript and PCL, access to D^2T^2 printers is limited. For example, these printers cannot run PC Magazine Labs' printer test suite.

These expensive devices are used for prepress, scientific, and medical applications. As prices drop and additional electronic photography applications are released, the market for high-quality color hard copy will expand dramatically. Potential applications include electronic photography, prints from video cameras, desktop publishing, advertising, and all the traditional color tasks now performed by ink jet, thermal wax transfer, and solid-ink printers.

HOW D^2T^2 WORKS

The printer transfers material from a roll of dyes onto either paper or a transparency, using nibs to heat a roll of special dyes. The roll usually contains alternating bands of cyan, magenta, and yellow dyes, yielding 24-bit true-color images. Some manufacturers are adding a black dye section, which produces full 32-bit color.

While the operation is similar to that of thermal wax transfer printers, D^2T^2 units can vary the heat when transferring color. This allows up to 256 steps for each pixel, with the dyes blended to form millions of colors. The result is a true continuous-tone image. The process is closer to photography's use of grains of silver coupled with dyes than to laser printing.

Selecting a dye transfer printer is not an easy task, because traditional methods of evaluating quality do not necessarily apply. There are no standards for resolution, which is not as important a factor as it might seem. Since D^2T^2 images do not rely on either dithering or halftoning to simulate tones, the dot-per-inch resolution is less important than the quality of the dyes and print media. It is more useful to compare pixels per inch (ppi) than dots per inch (dpi). The effective resolution of a D^2T^2 printer can be calculated by multiplying the pixels per inch by the number of dyes used to create the image. The most advanced 300-ppi units equal the quality of a 2,400-dpi laser-based device.

There is no standard image area or paper size in the D^2T^2 marketplace. Some printers can print right to the edge of the paper, while others leave wide margins. Not all printers accept letter-size materials. It is important to be sure that a printer can deliver a large enough image to suit your needs.

Each printer requires a custom software driver, and many use hardware interfaces such as the IEEE-488 General Purpose Interface Bus (GPIB) or an RGB connector. Prospective buyers should carefully analyze their requirements, and they may have to consider compatibility more important than price to be certain of getting what they need. If the printer is slated for network use, be sure that the unit can be integrated with the other equipment you use. Make certain that your important file formats and programs are fully supported.

ON THE MARKET

The following D^2T^2 printers are currently available:

The **DuPont 4Cast SP-120,** from E.I. DuPont's Printing and Publishing Division, Wilmington, Delaware (800-242-2424), can produce 11.9- by 17.3-inch true-color images at 300 ppi. The unit accepts either A3- or A4-size paper and can be used to print two 8.5- by 11-inch prints side by side. It is the only four-color (32-bit) D^2T^2 printer in production. The 4Cast prints only Targa files from the PC, but drivers for other formats are expected soon. It requires a custom TCP/IP Ethernet interface, which increases the $27,000 base price to $40,000.

The **Kodak XL 7700,** from Eastman Kodak Co., Rochester, New York (800-445-6325), is a 200-ppi printer costing $24,895. It can produce an image up to 11 inches square (with a half-inch border), and it accepts both 8.5- by 11-inch and 11- by 11-inch paper or transparency material. The unit is shipped with either a SCSI or a GPIB interface and requires a driver from Kodak or a third party. Several vendors, including AutoGraph International of San Jose (408-436-7227) and Zenographics of Irvine, California (714-851-6352), are producing *SuperPrint* drivers for the XL 7700.

Mitsubishi Electronics America of Cypress, California (714-220-2500) is offering the **Mitsubishi S340-10** for $13,995. It provides 150-ppi resolution with an 8.1- by 9-inch print area on 8.5- by 11-inch paper, or an 8.1- by 11-inch print area on legal-size paper. The unit is shipped with a Centronics parallel interface. Customers can choose among four drivers bundled with the printer, including a special version of Zenographics' *SuperPrint* for printing

Dye Diffusion

CONTINUED

from *Microsoft Windows* applications.

Mitsubishi International Corp., White Plains, New York (914-997-4999), is selling the **Mitsubishi CHC-S445 Dye Sublimation Printer** for a basic price of $18,000. After our testing period ended, the company began selling a unit with a single-pass buffer for $24,800, including Pipeline PowerPage PostScript compatibility and a Centronics interface. Because the CHC-S445 supports Super A-size (9- by 12-inch) paper, it can print the full area of an 8.5- by 11-inch page.

Nikon, Melville, New York (516-547-4200), gives a list price of $13,595 for the **Nikon CP-3000.** It provides 200 ppi and a maximum print area of 5 by 6.3 inches on 6- by 7-inch paper. The unit is shipped with Centronics, GPIB, RGB, and SCSI interfaces. Printing is accomplished via a special export filter. You'll need a driver such as Aldus/U-Lead's *PhotoStyler* operating under *Microsoft Windows*.

Seiko Instruments USA, San Jose, California (408-922-5800), offers the **Seiko Professional ColorPoint,** priced at $19,999. It provides three-color or optional four-color dye prints at 300 ppi via an RGB interface. Depending on the configuration, it can accept letter, legal, A, Super A, A4, or B4 formats. On A-size paper, the printable area is 8.1 by 8.6 inches, and the maximum printable area is 8.5 by 11.9 inches.

COMING SOON

Lasertechnics of Albuquerque, New Mexico (505-822-1123) is planning to ship the **Lasertechnics StarBurst Dual Mode Dye Diffusion/Wax Thermal Printer** in early 1992. The plans are to provide a unit that can print using either technology on different media at 300 ppi via a Centronics, SCSI, or high-speed parallel interface. The StarBurst is expected to cost $15,000 and provide an 8.2- by 8.5-inch image on 8.5- by 11-inch media. ■

at $9,995. Tagging along is the Tektronix Phaser II PXi, a conventional thermal wax printer with the same controller, priced at $7,995. Both use Adobe PostScript Level 2, unlike any of their color PostScript competitors.

Both hail from a venerable American company that has been making professional test equipment, including oscilloscopes, since 1945. From a novel oscilloscope tube design called DVST (direct view storage tube), Tektronix broadened from scopes to workstations, and then to workstation printers.

Today, the company offers a full line of color printers, starting with the Tetronix Phaser IISX, a $4,995 thermal wax transfer printer that supports PostScript only through off-the-shelf software, such as *Freedom of Press*. For $1,000 you can add a Tektronix PostScript interpreter with a controller based on the Motorola 68020 processor. Another $2,000 adds the RISC processor–based PXi controller, yielding the same $7,995 price and hardware as the Phaser II PXi.

The speedy PXi controller is based on an Advanced Micro Devices AMD 29000 RISC processor operating at 24 MHz. The board comes with 6MB RAM in the Phaser II PXi, 10MB RAM in the Phaser III PXi. Each can be upgraded in 4MB increments, at $995 each, to a maximum of 18MB.

Both printers feature three standard interfaces: parallel, serial (operating at up to 38,400 bits per second), and AppleTalk. The PXi controller automatically selects the active port. A SCSI port is available for adding a hard disk to store downloadable fonts.

SOLID INK

One look and you know the Phaser III is not like other printers. For one thing, it's bigger, measuring 13 by 28 by 35 inches once its largest paper tray is installed. But the real interest of this machine lies in the solid-ink technology, which promises to drive down the cost of high-quality color output. Not only is it able to produce plain-paper output at the same top-quality 300-dot-per-inch resolution as other color PostScript printers, the solid-ink design also delivers a lower cost per page than any other printer in its class.

Solid-ink technology is easy to describe and hard to execute (as was proven by the first printer to try it, the Howtek Pixelmaster, reviewed in our printer block-

buster of November 14, 1989). Basically, a solid ink jet is an ink jet with a difference.

Unlike volatile ink, which dries quickly as the solvent in it evaporates or soaks into the paper, solid ink is melted and then sprayed as tiny dots onto the printing medium. The dots cool quickly, changing phase from liquid to solid (thus the name *phase change*). The Pixelmaster stopped there, leaving little lumps of plastic-based inks on the paper and often clogging the printhead.

Tektronix improved on the original by reformulating the inks to be less brittle, somewhat like a crayon, with a bit of dye in a fatty wax. Tektronix added a "cold fuser," a steel roller that squashes the ink dots flat as the printing medium rolls out of the printer. This smooths the image and allows for brighter, more transparent colors that work well for paper and transparency media. Moreover, the ink doesn't clog.

Paper feeds into the Phaser III PXi from either of two automatic-feed trays. One holds sheets nearly 12 inches square; the other holds sheets of 12 by 17 inches. There is also a manual-feed slot at the top of the printer, which can handle media from 0.003 to 0.010 inches thick. Printed paper slides into the lower tray on the front of the printer. Consequently, normal operation requires access only to the top and front of the mechanism, although you will have to pull the printer away from the wall, or whatever is behind it, for maintenance.

EDGE TO EDGE

The paper feeds around a large steel drum, which clamps onto less than 1/8 inch of the leading edge. The paper travels in only one direction during printing, so only one end needs to be grasped. This allows for a large printed area that misses just the top and bottom lines of a full page (about 1/6 inch at 10 pitch).

Printing is done by a large printhead, roughly 5 by 5 by 5 inches, which holds reservoirs for the melted inks. The head shifts back and forth on a pair of chrome tubes, driven by a steel cable (though a high-quality print mode can be selected through software to make the Phaser III PXi unidirectional). The head takes about 2 seconds to make one pass across the drum and works somewhat like a line printer, laying down a narrow band of ink on each pass. It makes about 60 passes across the page, resulting in a print rate of roughly 2 minutes per page.

The Phaser III PXi's plastic case is more than 1/4 inch thick in places, and its internal chassis is made of even more rugged aluminum castings. Hinged sections of the case provide easy access to the paper path and internal mechanism; when you want to reach inside, the top pivots back and the rear panel pivots down.

A simple control panel is located at the right on top of the machine. Its two active push buttons are complemented by a 2-line, 25-character LCD. The top line normally monitors ink level with a three-position "fuel gauge" for each color, and the bottom line displays the current function of the printer. The push buttons, labeled Clean Print Head and Test Print, step you through the normal maintenance procedures, and Power and Error LEDs glow at the expected times (green and red, respectively). The normal line and form-feed buttons are absent.

Tektronix's philosophy is that everything should be handled from the PC; software is included for setting modes and controlling operations from the keyboard. Unfortunately, this software is not a pop-up TSR program.

SPILLPROOF

The printer is smart. It allows you access to the overflow ink tray only when it believes the tray is full. This prevents you from spilling hot ink into the mechanism, which could happen if you were to remove the drawer at an inappropriate time. You load ink in the form of solid sticks under a trap door above the control panel, and the printer is smart enough to stop you from inserting more ink than it can hold, preventing the printhead from overflowing. The LCD control panel tells you in plain English just what steps to take.

quality is what counts, and the Tetronix Phaser III PXi is good indeed.

Each ink color loads into a separate slot, and each ink stick is cast in a unique shape that fits only the appropriate slot. Putting the wrong color in a slot is as difficult as fitting a square peg in a round hole. One case of eight black ink sticks costs $119 ($14.88 per stick—expensive for a fat crayon), and an eight-stick case of one of the three colors costs $69. Color sticks are about half the size of black ones.

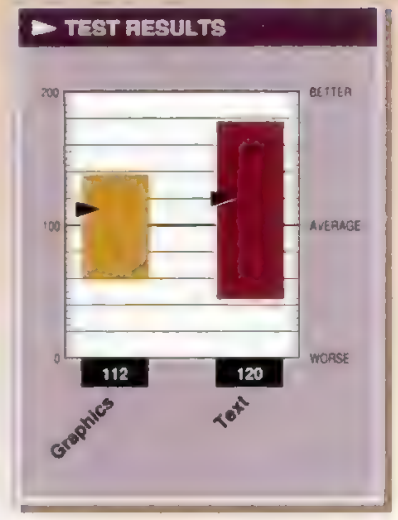
The life of a stick varies with the amount of ink sprayed on each page. According to Tektronix, a monochrome page with 5 percent coverage would use about 5 cents' worth of ink; a color page with 30 percent coverage would cost about 25 cents (compared with an average cost per page of roughly 60 cents for thermal wax printers). So with light coverage, the Phaser III PXi can print at a substantially lower cost than thermal wax machines. With heavy coverage, however, the others pull ahead; they cost the same per page no matter how much ink is used.

Quality is what counts, and the Phaser III PXi is good indeed. It has a wide tonal range, second only to the Seiko printers. And it appears to offer smoother gradations. The registration is perfect.

The one quality drawback is banding. Each pass of the printhead stands out in its default print mode. One pass of ink lies atop the previous one, resulting in a slight ridge. Enhanced mode reduces the banding, but does not quite eliminate it, by laying down every second line in alternate printhead passes. Nevertheless, the Phaser III PXi yielded one of the best renderings of PC Magazine Labs' halftone image.

The Phaser III PXi is not particularly quick when printing graphics images. But

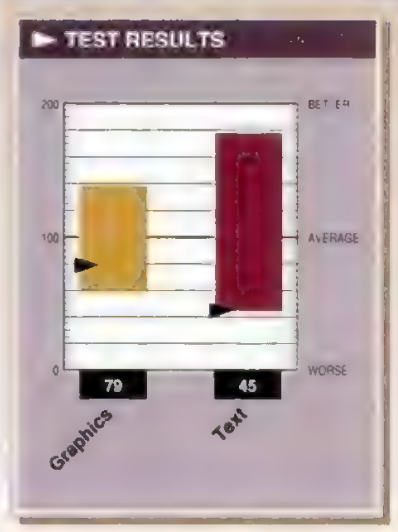
Tektronix Phaser II PXi



Color PostScript scores

In Short: The only thermal wax transfer printer in this roundup that supports Adobe PostScript Level 2, the Tektronix Phaser II PXi includes 39 fonts, but it gives you only a small printable area. And at $7,995, it's a bit more expensive than several of its competitors.

Tektronix Phaser III PXi



Color PostScript scores

In Short: The Tektronix Phaser III PXi is the only solid-ink printer we saw, and the only color PostScript unit that prints on plain paper. It offers a large printable area, and it can print on B-size paper; it uses Adobe PostScript Level 2 with 39 fonts. Its $9,995 price is offset by a low cost per page. Its output was slow, yet the quality was second only to the Seikos.

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it was able to beat a couple of the thermal wax engines in PC Labs' testing. And its RISC processor will make short work of vector images. In any case, speed is not the reason to buy the Tektronix Phaser III PXi. Its strengths are its low operating cost, versatility of media, PostScript Level 2 support, and solid construction.

LITTLE BROTHER

Unlike the Phaser III PXi, the Tektronix Phaser II PXi is an ordinary thermal wax transfer printer. It is comparatively compact, measuring only 15 by 17 by 27 inches including the two paper trays extending from the front. It occupies a 17-inch-square desktop space.

Its PXi controller differs from the common type of thermal wax machines. As with other thermal wax engines, it prints 300-dpi resolution on specially treated paper. It handles cut sheets of up to 8.5 by 14 inches, as well as letter, A4, and A4 Special media sizes, but the printable area is modest: 8.1 by 8.8 inches on an A-size sheet, 8.1 by 11.6 inches on legal-size.

The lower tray of the Phaser II PXi holds the media supply—up to 100 sheets of paper or 50 transparencies. Each sheet rolls into the printer around a large-diameter drum (just under 5 inches), which grasps it for one, three, or four passes against the thermal printhead. Printed pages are ejected, uncollated, into the upper tray in the front of the printer. Even with its front-mounted trays, you cannot put the Phaser II PXi directly against a wall. You need an additional 4 inches behind the machine to let you flip up the top to access its ink sheets and paper path.

Ink sheets are easy to load, thanks to the use of a tray carrier. The rolls lie in the carrier, which is dropped into the printing mechanism. No other adjustment is necessary. One-color ink sheets cost $160 and last for 1,100 pages; three-color cost $145 and last for 342 pages; four-color cost $150 and last for 275 pages.

With its thin plastic outer case (particularly noticeable on the front panel and sides), the Phaser II PXi has a cheaper feel than other Tektronix printers. Inside, however, it has a no-nonsense mechanism made mostly from heavy steel stampings; the only plastic you'll find is in the paper guides and the drive gears.

In the strict sense, the Phaser II PXi has no control panel but only a row of indicator LEDs labeled in both English and icons. These serve as warning lights for the common error conditions such as paper out, transfer roll out, and paper jams. All control functions are handled through software running on the host computer.

Choose the Tektronix II PXi for its print quality and PostScript Level 2 Support.

In terms of graphics output, the Phaser II PXi was no different from the rest of the pack of thermal wax printers; in other words, it was excellent. The text output was even better: The light elegance of the fonts was second only to those of the General Parametrics Spectra*Star 430. But the Phaser II PXi clipped the upper lines of text on a print sample; it was the only printer we reviewed that did. The unit was one of the quicker thermal wax printers, although not to an extraordinary extent.

Choose the Tektronix II PXi for its print quality (especially on text) and its PostScript Level 2 support. ■

FACT FILE

Tektronix Inc., P.O. Box 1000, Wilsonville, OR 97070; 800-835-6100.
Tektronix Phaser II PXi
List Price: $7,995; 4MB upgrade, $995.
Standard Warranty: One year on parts and labor with on-site service from Tektronix.
Dimensions (HWD): 15 x 17 x 27 inches.
Weight: 73 lbs.
Emulations: Adobe PostScript Level 2, HPGL.

EDITORS' CHOICE

Tektronix Phaser III PXi
List Price: $9,995; 4MB upgrade, $995.
Standard Warranty: One year on parts and labor with on-site service from Tektronix.
Dimensions (HWD): 13 x 28 x 35 inches.
Weight: 90 lbs.
Emulations: Adobe PostScript Level 2, HPGL.

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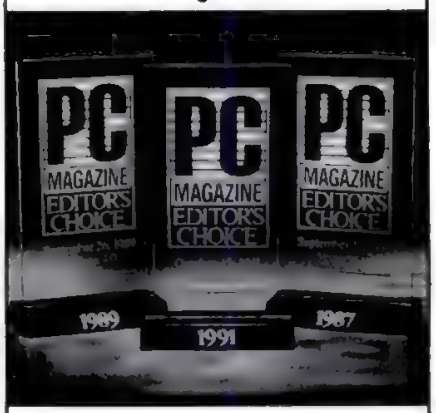

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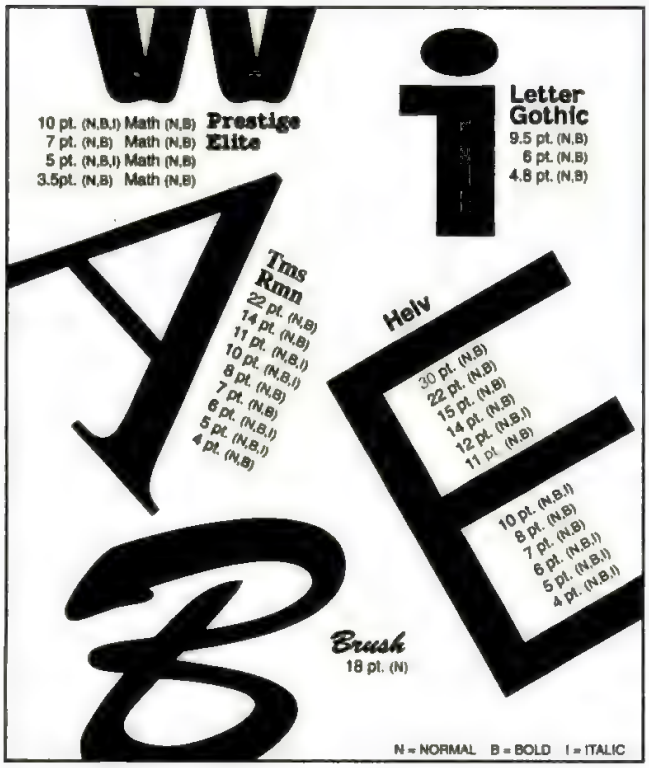

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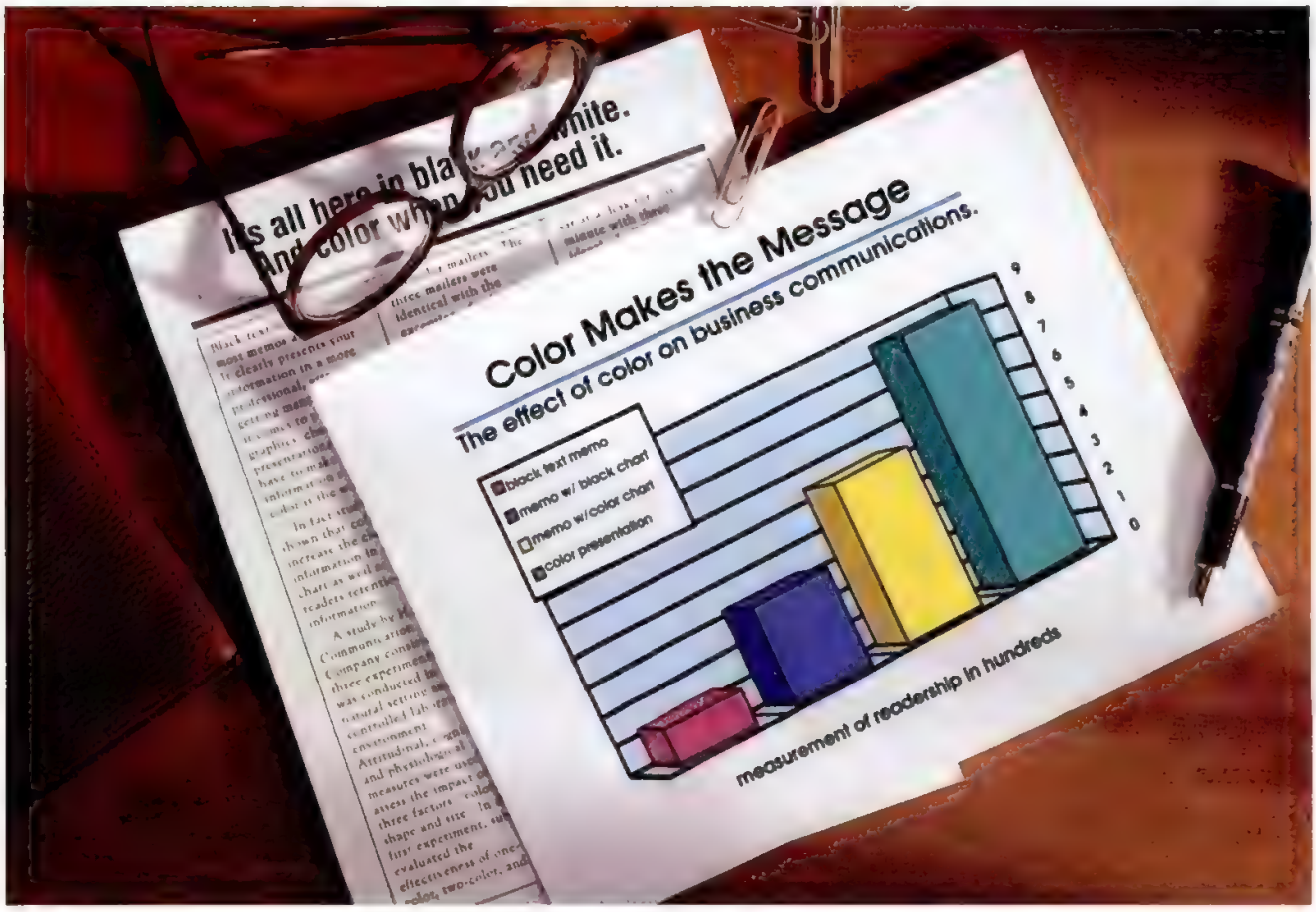

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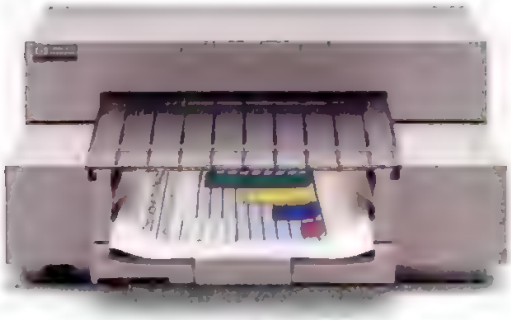

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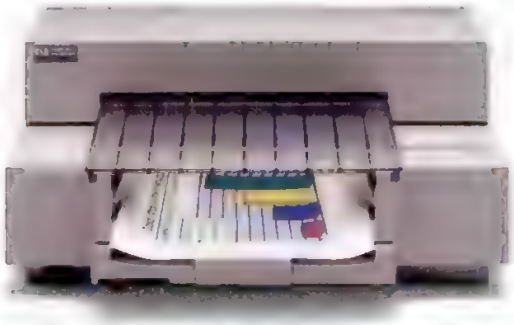

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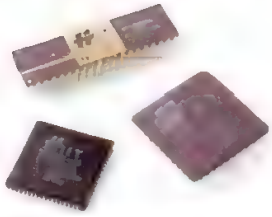

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(192 dots per inch for the Color 4 versus 180 dpi for the HP PaintJet), graphics will print smaller than normal when you use a PaintJet driver. If you use the provided driver for *Microsoft Windows*, Version 2.*x* or 3.*x*, or software that supports the Color 4, this will not be a problem.

The Kodak Diconix Color 4 Printer is a compelling addition to the color ink jet market. Given its built-in paper tray and its ability to produce vibrant colors on plain photocopy paper, one can easily forgive the printer its few faults. If you need a low-cost printer that can produce attractive color output for proofs, internal presentations, or medium-quality reports, give this printer strong consideration.

FACT FILE

Eastman Kodak Co., Printer Products Division, 901 Elmgrove Rd., Rochester, NY 14653; 800-344-0006.
Kodak Diconix Color 4 Printer
List Price: $1,495; with serial interface board and cable, $1,595; black ink cartridge, $13.95; color ink cartridge, $19.95.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 4 x 20 x 18 inches.
Weight: 13 lbs.
Emulations: HP PaintJet.

CIRCLE 414 ON READER SERVICE CARD

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IBM ExecJet Printer

Despite the IBM-style chassis, the $1,099 wide-carriage IBM ExecJet Printer looks very similar to the Canon BJ-330 Bubble Jet Printer (see the review in this issue). It also uses the same consumables and options, falls within the same price range, and performed virtually the same on PC Magazine Labs' speed tests. Basically, IBM Corp. has added its own chassis and documentation to the Canon USA engine, and the results are every bit as impressive as the Canon offering.

One apparent disparity between the two printers is price: At $1,099, the ExecJet lists for exactly $150 more than the BJ-330. The difference is easily explained when you notice that Canon sells its first cut-sheet feeder—conspicuously priced at $150—as an option, while IBM provides one as standard equipment. In other words, with the ExecJet, you get the first sheet feeder whether you want it or not and pay the same price.

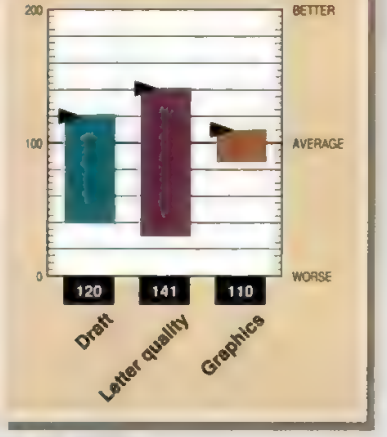
Other differences include the control panels. The ExecJet offers the same control-panel functions as the BJ-330—but in an altered layout—and the same list of emulations. Both printers use the same Epson LQ and IBM Proprinter emulations, but the ExecJet also supports the IBM Graphics Printer emulation.

If the IBM version earns any edge over the Canon, it lies with IBM's documentation. Canon scores points for including a separate programmers' reference, but IBM has done a better job with the user manual by including more detail and more illustrations.

The IBM ExecJet Printer is an excellent alternative to dot matrix printers for the same reason as its Canon counterparts: At 114 characters per second in letter-quality mode and nearly 198 cps in draft mode, it performs faster than the great majority of 24-pin dot matrix printers and does so without the noise. If you like the printer design and have no preference between Canon and IBM, shop around for the least expensive buy. You can expect to find the IBM at discounted prices of about $700 or lower.

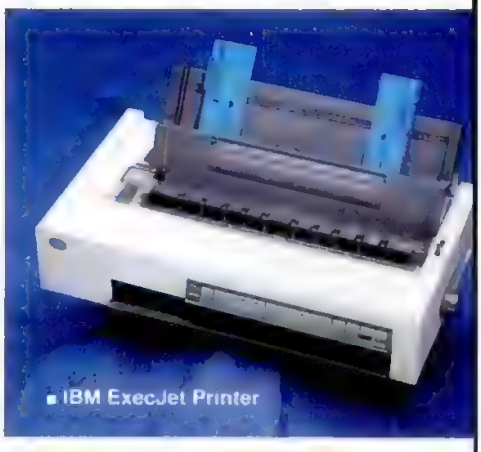
IBM ExecJet Printer

TEST RESULTS



Ink jet scores

In Short: Based on the same groundbreaking engine as the Canon Bubble Jets, the $1,099 wide-carriage IBM ExecJet printer offers an equally appealing package with equivalent performance. It accepts 17- by 23-inch sheets.



IBM ExecJet Printer

FACT FILE

IBM Corp./Lexmark, 740 New Circle Rd., Lexington, KY 40511; 800-426-2468.

EDITORS' CHOICE

IBM ExecJet Printer
List Price: $1,099; 128K RAM card, $259; font cards, $99 each; second 100-sheet paper bin, $129; serial interface board, $119; ink cartridge, $28.
Standard Warranty: One year on parts and labor through dealer.
Dimensions (HWD): 14 x 24 x 13 inches.
Weight: 19 lbs.
Emulations: Epson LQ, IBM Proprinter, IBM Graphics Printer.

CIRCLE 415 ON READER SERVICE CARD

STAR MICRONICS AMERICA INC.

Star Micronics StarJet SJ-48

In keeping with its focus on the home-office and small-business markets, Star Micronics America has added a sleek, capable portable machine to its expanding line of printers. The $499 Star Micronics StarJet SJ-48 uses the same Canon engine and notebook-size chassis that go into the Canon BJ-10e—a 1990 *PC Magazine* Editors' Choice ("Ink Jets," November 13, 1990). But Star Micronics deserves credit of its own for making an excellent product just a little better and for selling it with a two-year warranty.

Like the BJ-10e, the StarJet is about the size of a notebook portable—7 by 12 by 8 inches with its tray in its travel position—and weighs 4 pounds. The StarJet uses the same 64-nozzle ink cartridge, accepts the same 0.6-pound nickel cad-

NewWave for Windows. Never has $89 done so much for your organization.

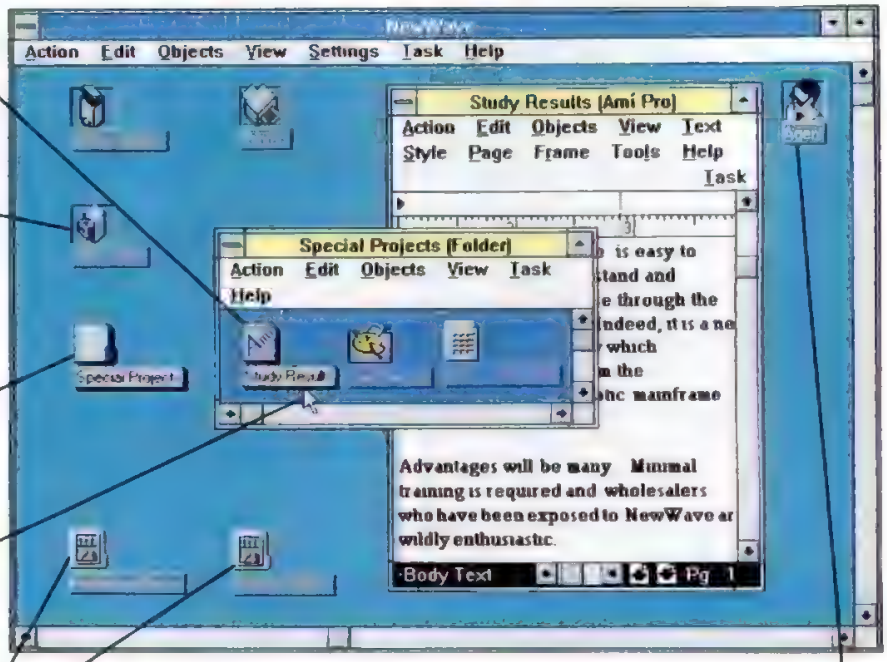
The premier desktop manager for Windows that does a lot more for your organization. Now at a price that's a lot less than what you'd expect. Take a look at all you get:

Icons: NewWave turns all of your existing DOS and Windows programs and files into icons for an easier-to-use desktop. Files can have 32 character names. Easily move files around the desktop by "dragging and dropping."

File Cabinet: On your real desk are documents in folders. Your folders are in a file cabinet. NewWave organizes your PC desktop the same way – by project with folder icons, and with a file cabinet for storing folders.

Folders: Finally, you can file your spreadsheet, word processor and graphics documents together by project, for easy access.

Launch & Load: Just click on an icon – both the file and it's program open simultaneously – NewWave has linked them together automatically. This means you no longer need to understand the Windows program and file managers to get your work done.



The Work Group Library makes it easier for you to share information with co-workers. We've done away with network menus and DOS commands, so you can focus on what you want to do – to share information with colleagues as you work together on the same project. To share text, graphics, and even spreadsheets, simply drag the file icon onto the server icon and your document is immediately available to others on your network. NewWave will track revisions, as well. So an entire group can work on your project and you will know when data has been changed and who has changed it. Welcome to document sharing, the easy way; the NewWave way.

NewWave's Agent brings automation to Windows. Let "The Agent" watch you complete a task just once, like the monthly update of a budget or sales report, and he'll complete the same job for you again and again using your existing software applications. You can even automate "The Agent" to work across applications and networks to gather the information you need. And he's far easier to set up than the Windows' macro-recorder – because he remembers your steps while you execute them and allows you to edit right then or make changes later. By using his calendar, you can schedule work for him days or weeks in advance. Just think of how much extra time you'll save by turning "The Agent" loose on all of your recurring tasks.

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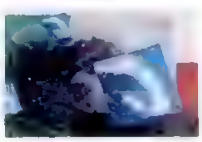
*Limited time offer. Limit one per customer.



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CIRCLE 157 ON READER SERVICE CARD

mium battery pack (sold as a $50 option), and produces the same crisp and dark text as the BJ-10e. It also suffers from the same meager paper-handling options: Unless you care to laboriously feed sheets one at a time or use fanfold paper with the friction-feed mechanism, you'll need to buy a 30-sheet cut-sheet feeder—a $90 option.

Star Micronics StarJet SJ-48

The most significant differences between the two printers concern their emulations and fonts. Like the BJ-10e, the StarJet emulates the IBM Proprinter and has an NEC Graphics mode, but its default emulation is the Epson LQ rather than the Canon BJ-130e. As for typefaces, the StarJet eschews the Canon BJ-130e Courier, Elite, and Prestige triad in favor of a true Epson LQ duo: a serif font that approximates Times Roman and a sans serif font that looks something like Helvetica. Star Micronics' StarJet also handily supports each font in its various sizes and spacings, all the way down to the half-height, half-width variations of the standard 10-, 12-, and 15-pitch fonts. This means you should have no problem squeezing 136 or 160 characters legibly across a page when you are printing out worksheets.

> *The StarJet's text quality is superb and much better than you'll find with many desktop inkjet printers, although the typefaces seem oddly designed.*

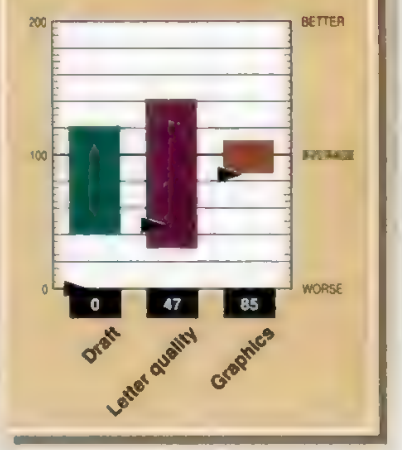
Star Micronics has also added auto-loading to the printer: The SJ-48 automatically loads paper to the top-of-form position when using either the sheet feeder or the manual friction feed. The company has added three functions to the control panel: eject page, set top of form, and lock-in panel settings. Unfortunately, the panel can be somewhat confusing to use, in part because it offers no visual confirmation of selected fonts or pitches.

During PC Magazine Labs' speed tests, the StarJet performed as one would expect given its 83-characters-per-second rating: 83 cps in letter-quality mode (it doesn't offer draft mode). When tested using the small sheet feeder, which adds only 2 pounds to the printer's weight, the StarJet printed a two-page text sample at 34 cps. As with the Canon portable, the Economy mode of the StarJet lessens ink usage but does not affect print speed.

The text quality is superb and much better than you'll find with many desktop ink jet printers, including those reviewed here. Star Micronics' typefaces seem oddly designed, however; the loop in the *p* of both typefaces fails to descend to the baseline, for example. But even when we used standard photocopy paper, the text appeared dark and nearly as smooth-edged as that of laser printer output. The StarJet also proved capable of producing exceptionally dark shadings on our graphics sample, but the photograph suffered from a good bit of posterizing under its Epson emulation. Under the Proprinter emulation, the graphic was free from significant posterizing, but it suffered from severe banding.

Star Micronics StarJet SJ-48

TEST RESULTS



Ink jet scores

In Short: The $499 Star Micronics StarJet SJ-48 should join the Canon BJ-10e at the top of the traveler's wish list. It builds on the same excellent engine and case design but offers several different features.

The Star Micronics StarJet SJ-48 does not have a draft mode.

If you're looking for a portable printer that is capable of high-quality output and you are not concerned with speed, the StarJet should land at the top of your list. It is possible to find the StarJet at a discounted street price of $300 or less, and when this consideration is coupled with Canon's cleverly designed sheet feeder, it can almost make you forget you're not using a desktop printer. As long as you are going to be satisfied with the Star Micronics StarJet SJ-48's fonts and emulations, its two-year warranty should be the deciding factor. ■

FACT FILE

Star Micronics America Inc., 420 Lexington Ave., #2702, New York, NY 10170; 212-986-6770.

Star Micronics StarJet SJ-48

List Price: $499; 30-sheet paper bin, $90; nickel cadmium battery pack, $50; ink cartridge, $25.

Standard Warranty: Two years on parts and labor through authorized service centers.

Dimensions (HWD): 7 x 12 x 8 inches.

Weight: 4 lbs.

Emulations: Epson LQ, IBM Proprinter, NEC Graphics Printer.

CIRCLE 416 ON READER SERVICE CARD

Compudyne Notebooks:

386SL/20 Notebook†† VGA Mono, 60 MB

$2199

- Intel 80386SL 20 MHz processor
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We dare you to compare it to any current model on the market. Its brilliance, the depth of its color mapping and full 10" size make working with our SL Notebook a pleasure.

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A rarity in notebooks! Full travel operation, tactile feedback, and full size keycaps!

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386SX/16 Notebook††
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$1499

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- 1.44 MB, 3 1/2" internal floppy drive
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- 6.5 lbs., 8.5" x 11" x 2.5"
- 3-hour battery pack
- MS-DOS 5.0 and file transfer utilities

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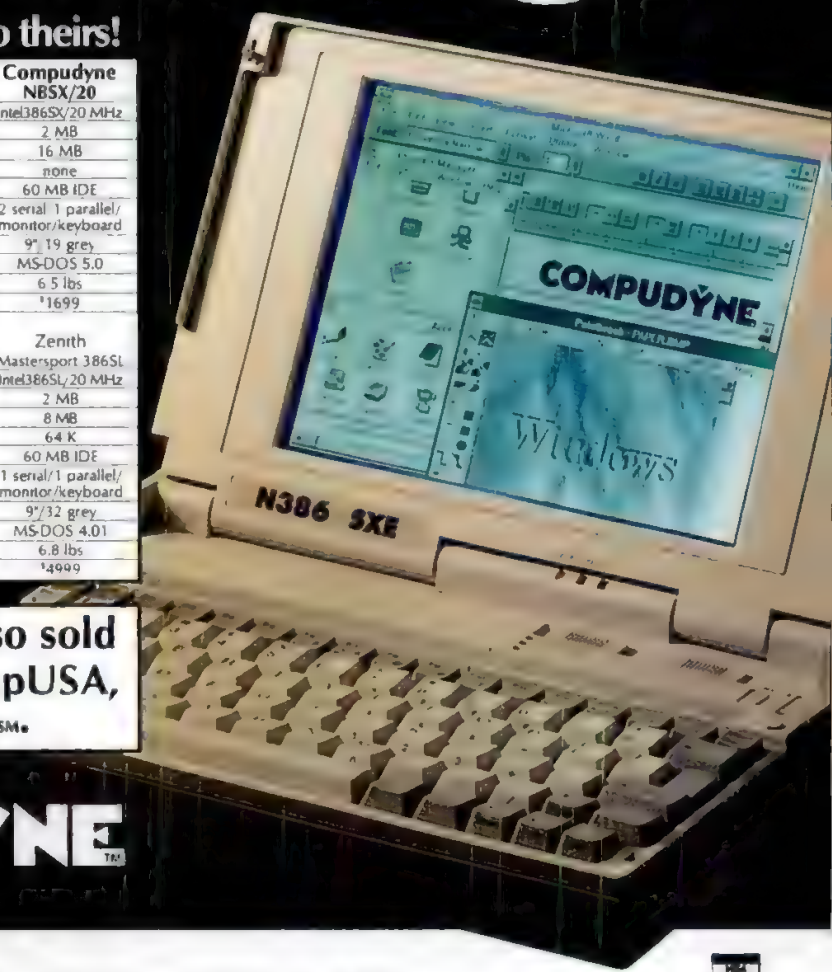
CPU	Intel386SX/16 MHz	Intel386SX/16 MHz	Intel386SX/16 MHz	Intel386SX/20 MHz
Std. Memory	2 MB	1 MB	2 MB	2 MB
Max. Memory	16 MB	3 MB	6 MB	16 MB
CPU Cache	none	none	none	none
Hard Drive	40 MB IDE	20 MB IDE	30 MB IDE	60 MB IDE
I/O Ports	2 serial/1 parallel/ monitor/keyboard	1 serial/1 parallel/ monitor	1 serial/1 parallel/ monitor/keyboard	2 serial 1 parallel/ monitor/keyboard
Screen	9"/16 grey	10"/16 grey	10"/32 grey	9"/19 grey
Software	MS-DOS 5.0	none	MS-DOS 4.01	MS-DOS 5.0
Weight	6.5 lbs	7 lbs	6 lbs	6.5 lbs
Price	$1499	$1995	$1995	$1699

	ZEOS 386SX-20	Northgate 386SX/20	Compudyne NBSL/20	Zenith Mastersport 386SL
CPU	Intel386SX/20 MHz	Intel386SX/20 MHz	Intel386SL/20 MHz	Intel386SL/20 MHz
Std. Memory	1 MB	1 MB	2 MB	2 MB
Max. Memory	5 MB	5 MB	8 MB	8 MB
CPU Cache	none	none	64 K	64 K
Hard Drive	20 MB IDE	40 MB IDE	60 MB IDE	60 MB IDE
I/O Ports	1 serial/1 parallel/ monitor	2 serial, 1 parallel/ monitor/keyboard	2 serial/1 parallel/ monitor/keyboard	1 serial/1 parallel/ monitor/keyboard
Screen	10"/16 grey	8.5"/32 grey	10"/64 grey	9"/32 grey
Software	none	MS-DOS 5.0	MS-DOS 5.0	MS-DOS 4.01
Weight	7 lbs	6.1 lbs	6.4 lbs	6.8 lbs
Price	$2295	$2799	$2199	$4999



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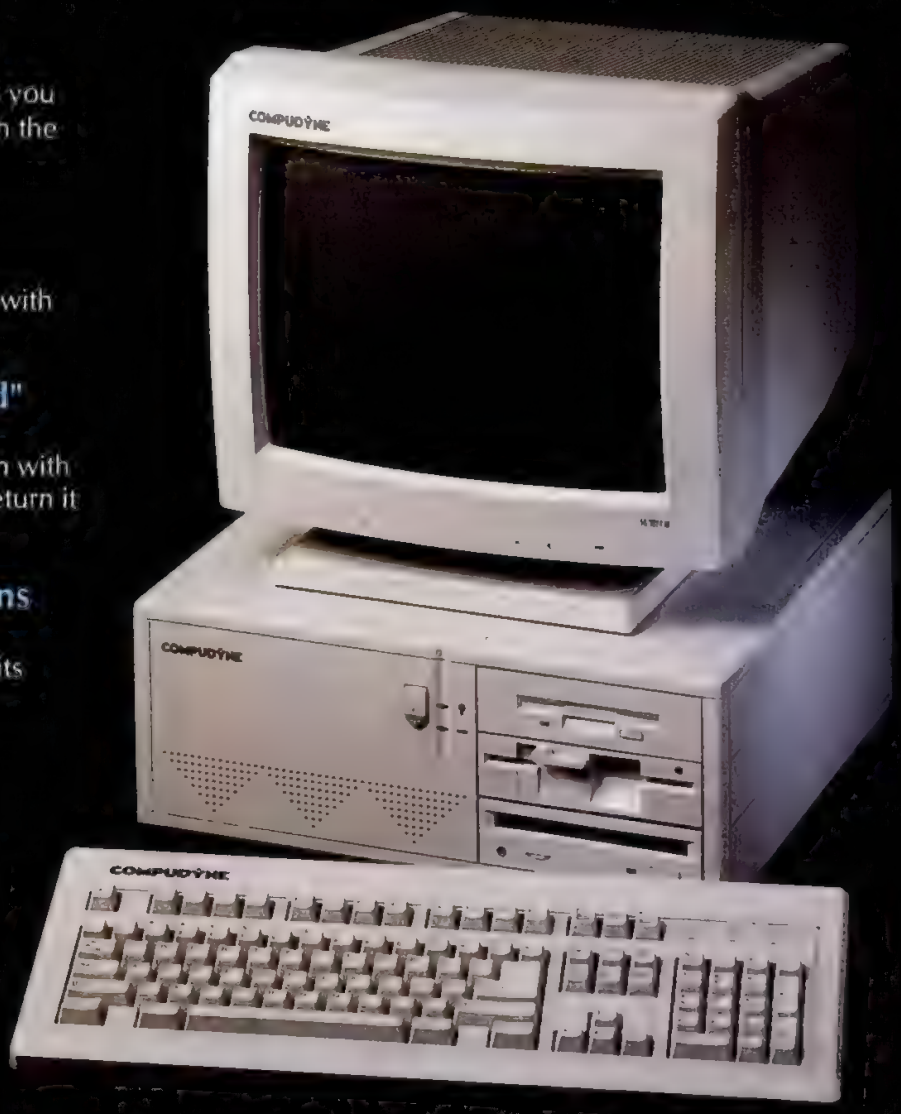
Just two ways we work with your company to give you the best service.



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- 101 keyboard

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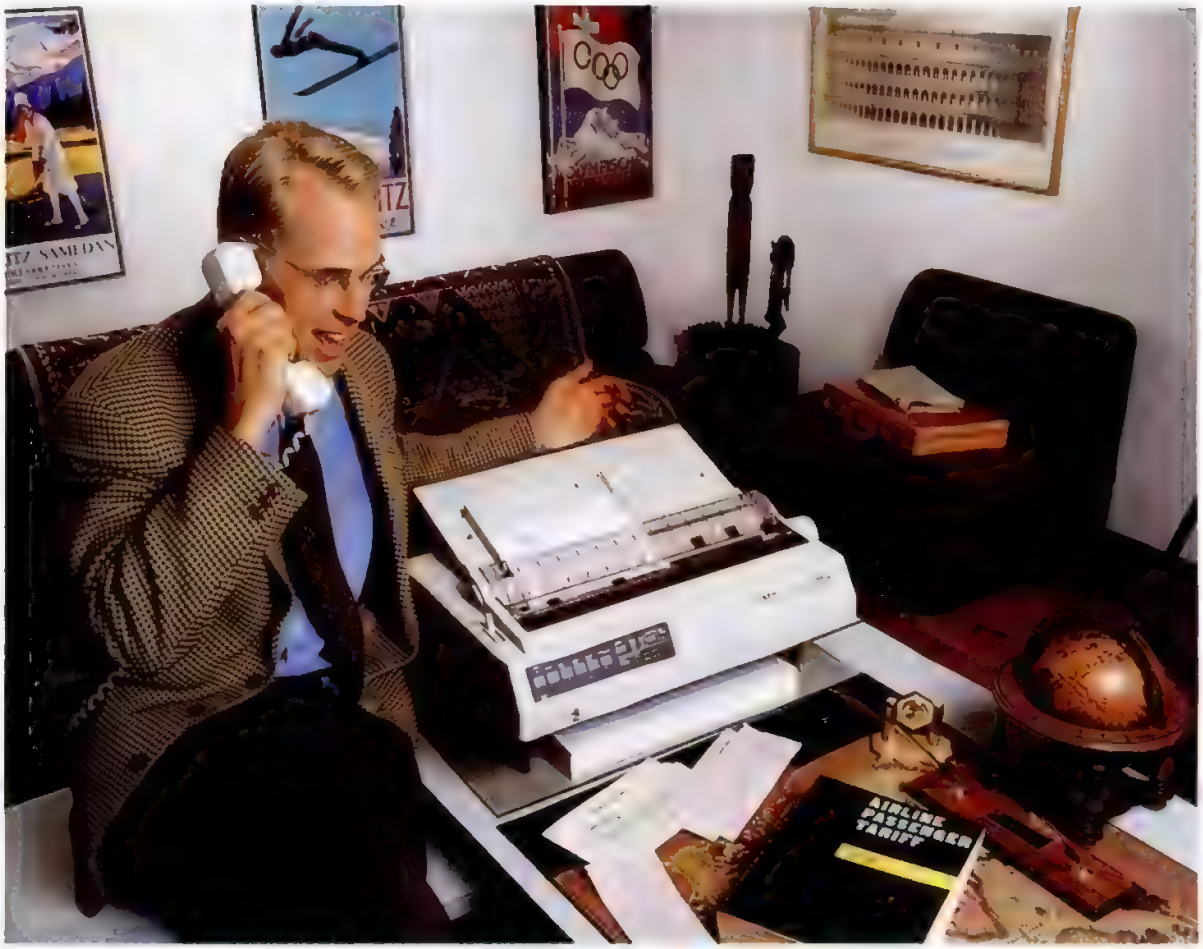
PCM1212

CIRCLE 132 ON READER SERVICE CARD

If your office really gives your printer the business, it better wear the Okidata OK!™



Today, a small business has to be all business to succeed – right down to the printer that keeps the paperwork moving. That single printer has to pretend it's three or four different printers – cranking out professional-looking business correspondence, lengthy proposals, invoices, multi-part forms, payroll checks, envelopes, and shipping labels without skipping a beat.

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Finally, we add a feature as important as any item on our spec sheets: the Okidata OK! It's nothing less than our personal pledge to you that every Okidata printer we sell will provide not only acceptable, but outstanding performance; not just adequate, but exceptional value.

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CIRCLE 229 ON READER SERVICE CARD

dot Matrix

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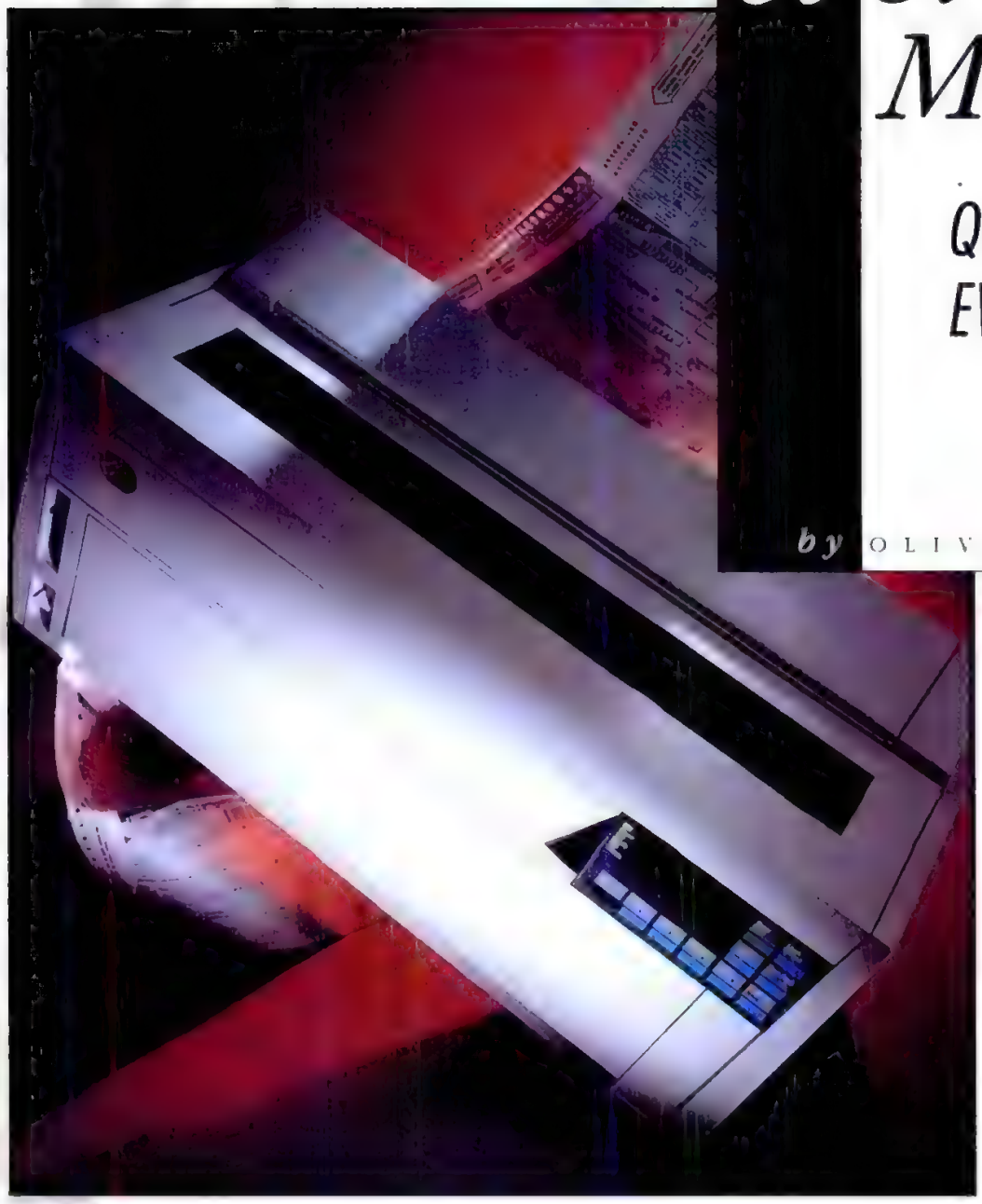


PHOTOGRAPHY RICK BECKER

Is the dot matrix printer market declining? Yes, but it's not dead, and to prove it, PC Magazine Labs tests 47 new dot matrix printers built to survive in a hostile market.

Like the Brazilian rain forests, the 1991 dot matrix market is deteriorating. Impact printers are engaged in a fierce struggle for market share with ever-improving nonimpact technologies. According to BIS Strategic Decisions, after experiencing a climb throughout the 1980s, dot matrix printer sales have decreased 3 percent this year—to only 5.2 million units sold—and

they're expected to fall even lower next year, to 4.9 million. A breakdown of the statistics shows that only the 24-pin dot matrix printers have seen any sales growth since 1989; both 9- and 18-pin printer sales have been steadily declining, with 9-pin printers falling slightly faster (from 3.4 million in 1989 to only 2.7 million this year).

Most dot matrix printer manufacturers are waging an all-out price-versus-features battle (more than half the printers reviewed list between $200 and $600 and were marketed as cheaper desktop alternatives to low-end laser printers). Other manufacturers are rigidly defining their market territories, whether letter-quality spreadsheet work, rugged high-speed multipart forms, or data processing.

LOW-END CHOICES

The low-end 9-pin printer market has changed little in the past year, with all the units reviewed here demonstrating remarkable similarities in price and features. Because of the indistinguishable nature of 9-pin dot matrix printers, we did not award an Editors' Choice for this category. Shopping for the lowest price tag may be your best bet (the lowest price in the 9-pin printer roundup belongs to the Star Micronics NX-1001 Multi-Font, which is street-priced at only $126), but don't ignore 24-pin printers.

With low-end laser printers moving ever downward on the price scale, 24-pin dot matrix printer vendors are forced to fight for customers. Prices are cut to a minimum—typically at the expense of features such as bottom paper-feed paths or front-mounted power switches. There are entry-level 24-pin printers, such as the Panasonic KX-P1123 and the Brother M-1324, available for about $200 on the street. Even if you think a 9-pin printer is all you can afford, the 24-pin printer prices may still entice you.

SQUEEZING THE MIDRANGE

In the midrange-to-high-end 24-pin printer market, many people believed that innovations were dead, but two leading manufacturers proved them wrong. Epson America introduced its new LQ line, which includes three printers with an innovation in dot matrix technology: the ESC/P2 printer control language, which supports internal scalable fonts. However, the scalable abilities of the $499 Epson LQ-570, the $749 Epson LQ-870, and the $1,049 Epson LQ-1170 extend to only two fonts, and their sizes are limited to a range of 8 to 32 points. Furthermore, you cannot access the internal scalable fonts in *Microsoft Windows*. Epson originally said it had a driver for *Windows*, but PC Magazine Labs' tests indicate that this is not the case. Epson now claims that the printers are *Windows*-compatible (as every Epson printer is), but if you want scalable fonts in that environment, you'll need *Adobe Type Manager* or a similar product.

In the midrange-to-high-end 24-pin printer market, many people believed that innovations were dead, but two leading manufacturers proved them wrong.

Meanwhile, Panasonic Communications & Systems Co. devised a Super Quiet mode that actually works, and implemented it into its new $700 Panasonic KX-P2624. With this mode disabled, the KX-P2624 runs at about 63 dB, but with the Super Quiet mode on, Panasonic rates its printer at 43.5 dB—far below the 60-dB maximum sound level recommended by PC Labs. But if you opt for quieter printing, you'll pay a hefty performance penalty; PC Labs' tests rate the KX-P2624 at 55 characters per second in Super Quiet mode (draft quality) versus 111 cps with the whisper mode disabled.

HEAVY-DUTY AND LINE PRINTERS

Besides being a low-cost alternative to low-end laser printers, dot matrix machines are in demand for fast, rugged, self-sufficient printing. A growing market niche has emerged here: the 9- or 18-pin heavy-duty printer. These hefty machines cost from $2,000 to $3,500 and are designed to deliver as high a duty cycle as possible, with the speediest possible output, while keeping the price well below that of real line printers. There are seven printers from this category in this year's roundup.

At the top of the dot matrix price chain rests the massive line printer. Huge, expensive, and blindingly fast, such machines are pricey and will cost you $5,000 to $8,000 or more. Able to turn out reams of wide-carriage data processing pages or thick multipart forms at rocketing rates, line printers are in a class by themselves and represent one of the few impact market niches with growth potential.

CIE America is an impact printer manufacturer dedicated to the high end. "We're targeting our printers toward today's network environments," says Drew Smith, CIE America's marketing director. "In the future, we'll be taking the direction of putting our printers directly on the network as nodes and continuing to improve our paper-path choices and the types of paper our printers can handle. That is today's growth market."

THIS YEAR'S CROP

This year, we looked at 47 dot matrix printers: 25 24-pin machines, 12 9-pin printers, 5 18-pin printers, 1 portable thermal-fusion printer (the tiny Citizen PN48), and, reviewed comparatively for the first time, 4 PC-compatible line printers (the $2,295 CIE CI-250 LXP and the $5,595 CIE CI-500, the $7,000 Mannesmann Tally MT661, and the $6,345 Printronix P3240).

ALPS America, which introduced the ALPS DMX800 (a heavy-duty 18-pin printer) in September, was unable to ship a production unit to us in time for testing. There were also a substantial number of key dot matrix vendors who left their impact lines stagnant this year and instead concentrated only on improving their laser sales, notably C-Tech Electronics, Digital Equipment Corp., GCC Technologies, and Okidata.

Although sleek, sexy laser printers do seem to be receiving all the attention, dot matrix market niches are as viable as ever. They're still much cheaper to use than ink jet or laser printers, which run for approximately 5 cents or more per page in most cases. And efficient multipart forms capability—an old dot matrix standby—still eludes the laser and ink jet species. Laser printers capable of handling B-size paper (11 by 17 inches) cost upwards of $5,000, and even fast industrial print speeds are still much cheaper on the dot matrix end. On the subject of cost, Peter Bergman, managing director of printer

Brother M-1309

$299

18-pin narrow-carriage dot matrix printer

Editor: a person
whose business it
wheat from the cha
that the chaff is
12CPI **Bold** Underline
NLQ 10CPI **Bold** Unc

DRAFT TEXT SPEED	105 cps
LQ TEXT SPEED	31 cps
GRAPHICS SPEED	0.7 gppm
GRAPHICS TIME	1 min. 30 sec.

Brother M-1324

$399

24-pin narrow-carriage dot matrix printer

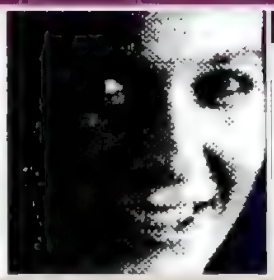
Editor: a person
whose business it
wheat from the cha
that the chaff is
10CPI **Bold** Underli
Script ***Bold*** *Underl*
Proportional 10CPI Bc

DRAFT TEXT SPEED	106 cps
LQ TEXT SPEED	49 cps
GRAPHICS SPEED	0.7 gppm
GRAPHICS TIME	1 min. 20 sec.

Bull Compuprint 970

$3,295

18-pin wide-carriage dot matrix printer



Editor: a person
whose business it
wheat from the cha
that the chaff is

10CPI Bold Underli
NLQ 10CPI Bold Unc

DRAFT TEXT SPEED	284 cps
LQ TEXT SPEED	131 cps
GRAPHICS SPEED	3.3 gppm
GRAPHICS TIME	0 min. 18 sec.

CIE CI-250 LXP

$2,295

Line printer

Editor: a person
whose business it
wheat from the cha
that the chaff is

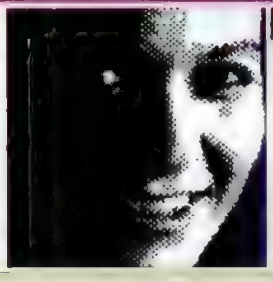
10CPI **Bold** Underli
NLQ 10CPI **Bold** Unc

DRAFT TEXT SPEED	349 lpm
LQ TEXT SPEED	88 lpm
GRAPHICS SPEED	2.9 gppm
GRAPHICS TIME	0 min. 20 sec.

CIE CI-500

$5,895

Line printer



Editor: a person
whose business it
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that the chaff is
:12CPI Bold Underl
NLQ 10CPI Bold Unc
Proportional 10CPI

DRAFT TEXT SPEED	370 lpm
LQ TEXT SPEED	119 lpm
GRAPHICS SPEED	2.1 gppm
GRAPHICS TIME	0 min. 28 sec.

Citizen GSX-130

$398

24-pin narrow-carriage dot matrix printer

Editor: a person e
whose business it
wheat from the cha
that the chaff is
Draft Bold Underli
Sans Serif Bold Ur
Proportional Bold Und

DRAFT TEXT SPEED 127 cps
LQ TEXT SPEED 55 cps
GRAPHICS SPEED: 1.6 gppm
GRAPHICS TIME 0 min. 38 sec.

Citizen GSX-140 Plus

$499

24-pin narrow-carriage dot matrix printer

Editor: a person empl
whose business it is t
wheat from the chaff
that the chaff is prin
Draft Bold Underli
Courier Bold Under

DRAFT TEXT SPEED 112 cps
LQ TEXT SPEED 53 cps
GRAPHICS SPEED 1.9 gppm
GRAPHICS TIME: 0 min. 30 sec.

Citizen GSX-145

$649

24-pin wide-carriage dot matrix printer

Editor: a person e
whose business it
wheat from the cha
that the chaff is
Draft Bold Underli
Courier Bold Under
Proportional Bold Und

DRAFT TEXT SPEED: 100 cps
LQ TEXT SPEED: 46 cps
GRAPHICS SPEED: 1.8 gppm
GRAPHICS TIME: 0 min. 33 sec.

PC Citizen PN48

$469

24-pin narrow-carriage dot matrix printer

Editor: a person empl
whose business it is t
wheat from the chaff
that the chaff is prin
Draft Bold Underli
Courier Bold Under

DRAFT TEXT SPEED: N/A
LQ TEXT SPEED: 24 cps
GRAPHICS SPEED: 0.5 gppm
GRAPHICS TIME: 1 min. 49 sec.

Citizen 200GX Fifteen

$499

9-pin wide-carriage dot matrix printer

Editor: a person e
whose business it
wheat from the cha
that the chaff is
Pica Bold Underlin
NLQ Pica Bold Unde
Roman Bold Underli

DRAFT TEXT SPEED: 100 cps
LQ TEXT SPEED: 29 cps
GRAPHICS SPEED: 1.1 gppm
GRAPHICS TIME: 0 min. 55 sec.

Datasouth Performax

$2,000

18-pin wide-carriage dot matrix printer

Editor: a person e
whose business it
wheat from the cha
that the chaff is
:12CPI Bold Underl
Resident NLQ Bold
Proportional 10CPI B

DRAFT TEXT SPEED	207 cps
LQ TEXT SPEED	88 cps
GRAPHICS SPEED	2.6 gppm
GRAPHICS TIME	0 min. 22 sec.

Datasouth XL-300

$1,500

9-pin wide-carriage dot matrix printer

Editor: a person e
whose business it
wheat from the cha
that the chaff is
Elite Bold Underl
NLQ Pica Bold Unde

DRAFT TEXT SPEED	184 cps
LQ TEXT SPEED	37 cps
GRAPHICS SPEED	1.6 gppm
GRAPHICS TIME	0 min. 38 sec.

Epson LQ-200

$300

24-pin narrow-carriage dot matrix printer

Editor: a person e
whose business it
wheat from the cha
that the chaff is
Draft Bold Underli
Courier Bold Under
Proportional Bold Und

DRAFT TEXT SPEED	89 cps
LQ TEXT SPEED	44 cps
GRAPHICS SPEED	1.6 gppm
GRAPHICS TIME	0 min. 37 sec.

PC Epson LQ-570

$499

24-pin narrow-carriage dot matrix printer

Editor: a person empl
whose business it is
wheat from the chaff
that the chaff is pri
Draft Bold Underli
Courier Bold Under
Proportional Bold Und

DRAFT TEXT SPEED	103 cps
LQ TEXT SPEED	55 cps
GRAPHICS SPEED	1.6 gppm
GRAPHICS TIME	0 min. 38 sec.

PC Epson LQ-870

$749

24-pin narrow-carriage dot matrix printer

Editor: a person e
whose business it
wheat from the cha
that the chaff is
Draft Bold Underli
Roman Bold Underli
Proportional Bold Und

DRAFT TEXT SPEED	141 cps
LQ TEXT SPEED	77 cps
GRAPHICS SPEED	3.0 gppm
GRAPHICS TIME	0 min. 20 sec.

Epson LQ-1170 — $1,040

24-pin wide-carriage dot matrix printer

DRAFT TEXT SPEED 140 cps
LQ TEXT SPEED 77 cps
GRAPHICS SPEED 2.9 gppm
GRAPHICS TIME 0 min. 20 sec.

Editor: a person e
whose business it
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Draft Bold Underli
Sans Serif Bold Ur
Proportional Bold Und

Fujitsu DL3600 — $840

24-pin wide-carriage dot matrix printer

DRAFT TEXT SPEED 154 cps
LQ TEXT SPEED 76 cps
GRAPHICS SPEED 0.8 gppm
GRAPHICS TIME 1 min. 16 sec.

Editor: a person e
whose business it
wheat from the cha
that the chaff is
Draft Bold Underli
Elite pitch Bold Under
Proportional Bold Und

Genicom 3840E — $2,585

18-pin wide-carriage dot matrix printer

DRAFT TEXT SPEED 212 cps
LQ TEXT SPEED 92 cps
GRAPHICS SPEED 2.1 gppm
GRAPHICS TIME 0 min. 28 sec.

Editor: a person empl
whose business it is
wheat from the chaff
that the chaff is pri

12CPI Bold Underline
12CPI Bold Underline

IBM Personal Printer Series II 2380 — $499

9-pin narrow-carriage dot matrix printer

DRAFT TEXT SPEED 153 cps
LQ TEXT SPEED 61 cps
GRAPHICS SPEED 1.6 gppm
GRAPHICS TIME 0 min. 38 sec.

Editor: a person e
whose business it
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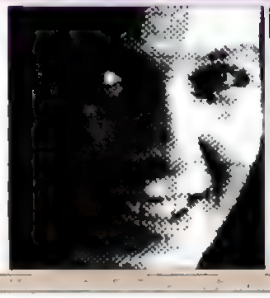
that the chaff is
10CPI Bold Underli
NLQ 10CPI Bold Und

IBM Personal Printer Series II 2381 — $699

9-pin wide-carriage dot matrix printer

DRAFT TEXT SPEED 162 cps
LQ TEXT SPEED 61 cps
GRAPHICS SPEED 1.7 gppm
GRAPHICS TIME 0 min. 36 sec.



Editor: a person e
whose business it
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that the chaff is
10CPI Bold Underli
NLQ 10CPI Bold Unc

IBM Personal Printer Series II 2390

$400

24-pin narrow-carriage dot matrix printer

Editor: a person e
whose business it
wheat from the cha
that the chaff is

10CPI Bold Underline Compresse
NLQ 10CPI Bold Und

DRAFT TEXT SPEED	112 cps
LQ TEXT SPEED	53 cps
GRAPHICS SPEED	0.9 gppm
GRAPHICS TIME	1 min. 10 sec.

IBM Personal Printer Series II 2391

$600

24-pin wide-carriage dot matrix printer

Editor: a person e
whose business it
wheat from the cha
that the chaff is

10CPI Bold Underline Compresse
NLQ 10CPI Bold Und

DRAFT TEXT SPEED	120 cps
LQ TEXT SPEED	56 cps
GRAPHICS SPEED	0.9 gppm
GRAPHICS TIME	1 min. 10 sec.

IBM Proprinter 24P

$400

24-pin narrow-carriage dot matrix printer

Editor: a person e
whose business it
wheat from the cha
that the chaff is

10CPI Bold Underline Compresse
NLQ 10CPI Bold Und

DRAFT TEXT SPEED	102 cps
LQ TEXT SPEED	47 cps
GRAPHICS SPEED	0.7 gppm
GRAPHICS TIME	1 min. 21 sec.

IBM 4226 Printer

$2,295

9-pin wide-carriage dot matrix printer

Editor: a person e
whose business it
wheat from the cha
that the chaff is

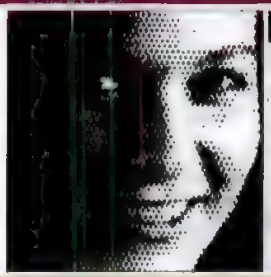
10CPI Bold Underli
NLQ 10CPI Bold Und

DRAFT TEXT SPEED	229 cps
LQ TEXT SPEED	65 cps
GRAPHICS SPEED	1.3 gppm
GRAPHICS TIME	0 min. 45 sec.

Mannesmann Tally MT82

$400

24-pin narrow-carriage dot matrix printer



Editor: a person e
whose business it
wheat from the cha
that the chaff is

12CPI Bold Underline
NLQ 10CPI Bold Und

DRAFT TEXT SPEED	73 cps
LQ TEXT SPEED	39 cps
GRAPHICS SPEED	1.0 gppm
GRAPHICS TIME	1 min. 0 sec.

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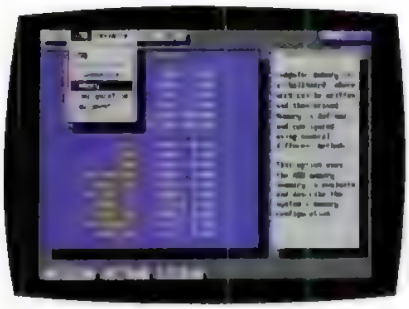
have to be a rocket scientist to use it.)



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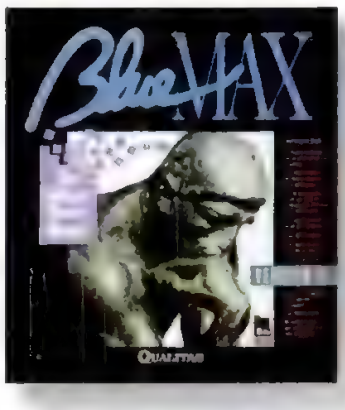

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CIRCLE 326 ON READER SERVICE CARD

Mannesmann Tally MT661 — $6,999

Line printer

DRAFT TEXT SPEED 674 lpm
LQ TEXT SPEED 327 lpm
GRAPHICS SPEED 3.5 gppm
GRAPHICS TIME 0 min. 17 sec.

Editor: a person
whose business it
wheat from the cha
that the chaff is
Draft Bold Underl
NLQ Pica Bold Und

NEC Pinwriter P3200 — $429

24-pin narrow-carriage dot matrix printer

DRAFT TEXT SPEED 104 cps
LQ TEXT SPEED 50 cps
GRAPHICS SPEED 0.3 gppm
GRAPHICS TIME 3 min. 59 sec.

Editor: a person employed
whose business it is to sep
wheat from the chaff and t
that the chaff is printed -H
Quick Gothic 10 Bo
e d
Courier 10 Bold Un

NEC Pinwriter P3300 — $599

24-pin wide-carriage dot matrix printer

DRAFT TEXT SPEED 102 cps
LQ TEXT SPEED 50 cps
GRAPHICS SPEED 0.3 gppm
GRAPHICS TIME 3 min. 58 sec.

Editor: a person employed
whose business it is to sep
wheat from the chaff and t
that the chaff is printed -H
Quick Gothic 10 Bo
Pica Bold Underlin
Times PS Bold Underline C

NEC Pinwriter P9300 — $1,395

24-pin wide-carriage dot matrix printer

DRAFT TEXT SPEED 162 cps
LQ TEXT SPEED 89 cps
GRAPHICS SPEED 0.4 ppm
GRAPHICS TIME 2 min. 41 sec.

Editor: a person employed
whose business it is to sep
wheat from the chaff and t
that the chaff is printed -H
Quick Gothic 10 Bo
Pica Bold Underlin
Times Ps Bold Underline C

Output DuraLine — $2,995

9-pin wide-carriage dot matrix printer

DRAFT TEXT SPEED 217 cps
LQ TEXT SPEED 52 cps
GRAPHICS SPEED 1.5 gppm
GRAPHICS TIME 0 min. 39 sec.

Editor: a person
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wheat from the cha
that the chaff is

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Panasonic KX-P1123

$369.95

24-pin narrow-carriage dot matrix printer

DRAFT TEXT SPEED 92 cps
LQ TEXT SPEED 45 cps
GRAPHICS SPEED 1.0 gppm
GRAPHICS TIME 1 min. 2 sec.

Editor: a person
whose business it
wheat from the cha
that the chaff is

10CPI Bold Underline Compresse
NLQ 10CPI Bold Unc

Panasonic KX-P1124i

$499.95

24-pin narrow-carriage dot matrix printer

DRAFT TEXT SPEED 107 cps
LQ TEXT SPEED 25 cps
GRAPHICS SPEED: 1.1 gppm
GRAPHICS TIME 0 min. 56 sec.

Editor: a person empl
whose business it is
wheat from the chaff
that the chaff is pri

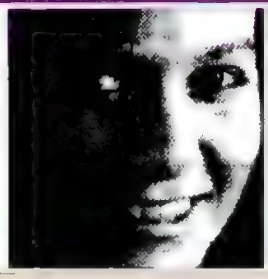
Bold
Elite pitch Bold Unde

Panasonic KX-P2624

$699.95

24-pin wide-carriage dot matrix printer

DRAFT TEXT SPEED. 111 cps
LQ TEXT SPEED 27 cps
GRAPHICS SPEED 1.3 gppm
GRAPHICS TIME 0 min. 47 sec.



Editor: a person empl
whose business it is
wheat from the chaff
that the chaff is pri

Draft Bold Underli
Elite pitch Bold Unde

Printronix P3240

$6,345

Line printer

DRAFT TEXT SPEED 290 lpm
LQ TEXT SPEED: 176 lpm
GRAPHICS SPEED: 4.9 gppm
GRAPHICS TIME 0 min. 12 sec.

Editor: a person e
whose business it
wheat from the cha
that the chaff is
10CPI HS Bold Unde
10CPI NLQ Bold Unc
10CPI DP Bold Unde

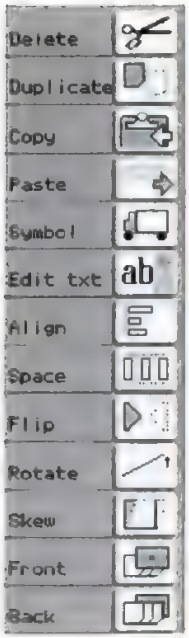
Seikosha BP 5780

$2,200

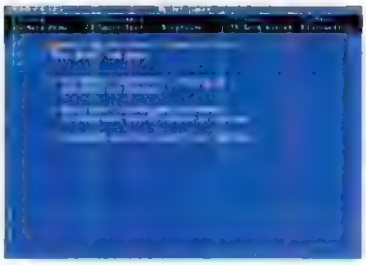
18-pin wide-carriage dot matrix printer

DRAFT TEXT SPEED 221 cps
LQ TEXT SPEED 69 cps
GRAPHICS SPEED: 1.5 gppm
GRAPHICS TIME 0 min. 41 sec.

Editor: a person e
whose business it
wheat from the cha
that the chaff is
Elite Bold Underline
Roman Bold Underli

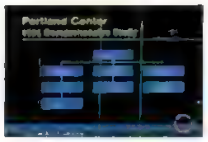


Drawing tools. 39 in all.

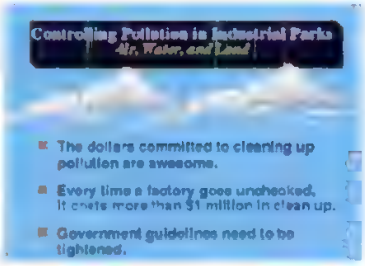


Do what you've always done before...

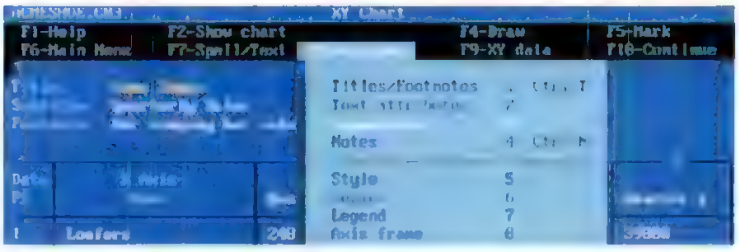
Twist it. Turn it.



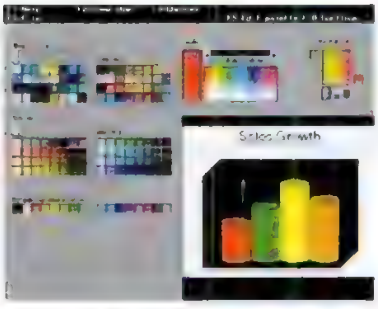
From titles to footnotes. From colors to logos. Our global options keep it consistent.



...style it like you've never seen before.



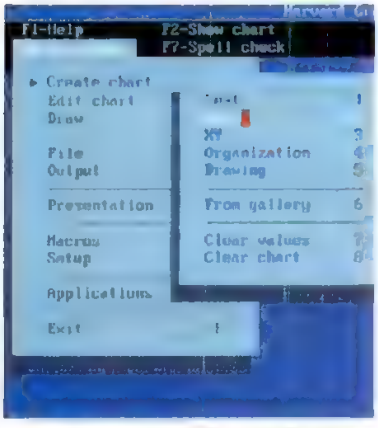
Pull-down menus: A new feature to get at the features. Easier than ever.



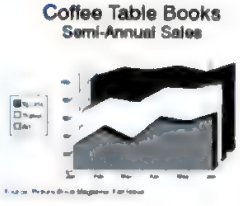
Choose from 32 color palettes. Then shade. Mix. Blend.

You enter the data, we'll make it look good. It's what you've known us for all along.

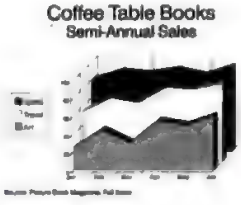
How do 16 million colors sound?



Look familiar? It should. It's Harvard Graphics.



What you see is what you get.



Yes, we have WYSIWYG.

Overwhelming evidence that Harvard Graphics® 3.0 is more than just another upgrade.

Our new DOS upgrade is loaded with features. Call 1-800-336-8360, Operator 772, for your own demo disk. And view the evidence yourself.

SPC SOFTWARE PUBLISHING

For $125, Harvard Graphics users can order 3.0 by calling 1-800-548-4772. Harvard Graphics 3.0 is a registered trademark of Software Publishing Corporation.

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Seikosha LT 20

$499

24-pin narrow-carriage dot matrix printer

DRAFT TEXT SPEED 23 cps
LQ TEXT SPEED 16 cps
GRAPHICS SPEED 0.4 gppm
GRAPHICS TIME: 2 min. 26 sec.

Editor: a person e
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:12CPI Bold Underl
12 CPI Courier Bold U

Star Micronics NX-1001 Multi-Font

$229

9-pin narrow-carriage dot matrix printer

DRAFT TEXT SPEED 97 cps
LQ TEXT SPEED 26 cps
GRAPHICS SPEED 0.9 gppm
GRAPHICS TIME 1 min. 3 sec.

Editor: a person e
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Star Micronics NX-1020 Rainbow

$299

9-pin narrow-carriage dot matrix printer

DRAFT TEXT SPEED 96 cps
LQ TEXT SPEED 34 cps
GRAPHICS SPEED 1.0 gppm
GRAPHICS TIME: 0 min. 58 sec.

Editor: a person e
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NLQ 10CPI Bold Und

Star Micronics NX-2420 Multi-Font

$449

24-pin narrow-carriage dot matrix printer

DRAFT TEXT SPEED 94 cps
LQ TEXT SPEED 43 cps
GRAPHICS SPEED 0.9 gppm
GRAPHICS TIME 1 min. 10 sec.

Editor: a person e
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Courier Bold Under
Proportional Bold Und

Star Micronics NX-2420 Rainbow

$499

24-pin narrow-carriage dot matrix printer

DRAFT TEXT SPEED 90 cps
LQ TEXT SPEED 43 cps
GRAPHICS SPEED: 0.7 gppm
GRAPHICS TIME 1 min. 22 sec.

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This is your dot matrix, printing.

This is our new quiet 2624, printing.

This is the one you've been waiting for. Panasonic® presents the first of a new generation of quiet dot matrix printers.

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It doesn't scream, it whispers. Through multi-part forms, those 'industrial strength' spreadsheets, and your customer correspondence. And does them all with ease, speed and the superb reliability we've built a reputation on. It has all the features you've come to expect from the leader in dot matrix printing. And then some. One super letter-quality and seven letter-quality fonts. Multiple paper paths. An LCD display. A top speed of 300 cps in draft mode, 100 cps in letter quality. A two-year limited warranty on parts and labor.* And serene quiet.

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Star Micronics XB-2420 Multi-Font — $749

24-pin narrow-carriage dot matrix printer

DRAFT TEXT SPEED 136 cps
LQ TEXT SPEED 39 cps
GRAPHICS SPEED 1.4 gppm
GRAPHICS TIME 0 min. 43 sec.

Editor: a person e
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10CPI Bold Underli
NLQ 10CPI Bold Unc
Proportional 10CPI Bc

Star Micronics XB-2425 Multi-Font — $949

24-pin wide-carriage dot matrix printer

DRAFT TEXT SPEED 135 cps
LQ TEXT SPEED 39 cps
GRAPHICS SPEED 1.4 gppm
GRAPHICS TIME 0 min. 42 sec.

Editor: a person e
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10CPI Bold Underli
NLQ 10CPI Bold Und
Proportional 10CPI

Star Micronics XR-1020 Multi-Font — $549

9-pin narrow-carriage dot matrix printer

DRAFT TEXT SPEED 137 cps
LQ TEXT SPEED 57 cps
GRAPHICS SPEED 1.9 gppm
GRAPHICS TIME 0 min. 31 sec.

Editor: a person e
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10CPI Bold Underli
NLQ 10CPI Bold Und
Proportional 10CPI E

Star Micronics XR-1520 Multi-Font — $699

9-pin wide-carriage dot matrix printer

DRAFT TEXT SPEED 137 cps
LQ TEXT SPEED 57 cps
GRAPHICS SPEED 1.2 gppm
GRAPHICS TIME 0 min. 49 sec.

Editor: a person e
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Pica Bold Underlin
NLQ Pica Bold Unde
Proportional Bold U

Tandy DMP 135 — $319.95

9-pin narrow-carriage dot matrix printer

DRAFT TEXT SPEED 99 cps
LQ TEXT SPEED 32 cps
GRAPHICS SPEED 1.3 gppm
GRAPHICS TIME 0 min. 46 sec.

Editor: a person e
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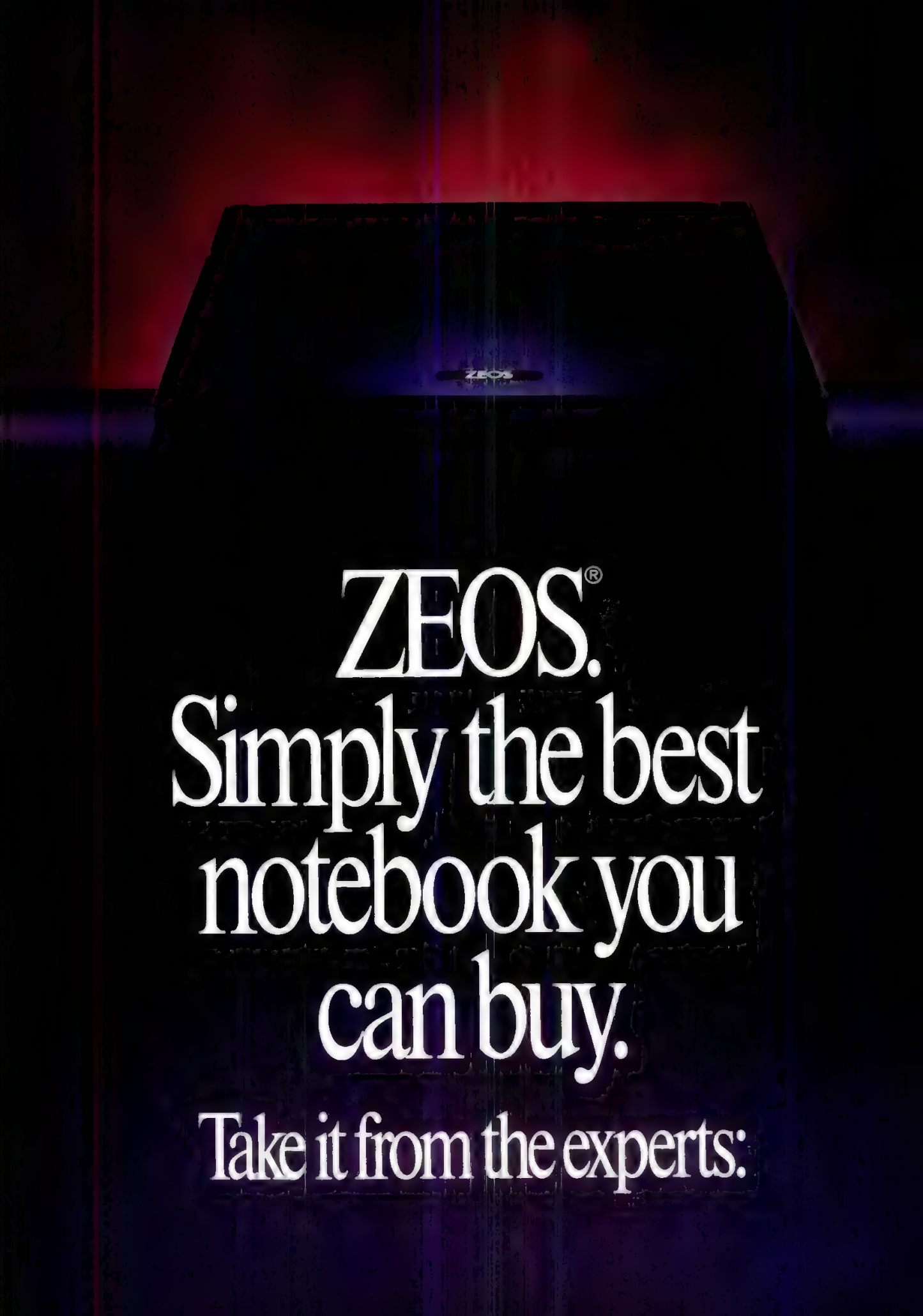
ZEOS®
Simply the best
notebook you
can buy.
Take it from the experts:

ZEOS NOTEBOOK 386

The ZEOS Guide to the Perfect Notebook:

PROCESSOR: PC Magazine recommends a '386SX processor pointing out that, "Finally, we've got portable PCs capable enough to be your *only* PC." That's why ZEOS offers you a 16MHz or a 20MHz '386SX! More power for you. After all it's just like a take-anywhere desktop!

DRIVES: *Two drives, built in!* A whisper quiet high speed 20 Megabyte or larger hard disk *plus* a 1.44 Megabyte 3.5 inch floppy. Remember, with a built in floppy drive you don't need to fool around with strange interfaces to load and transfer files.

VIDEO: ZEOS raises the ante to VGA! We're talking about bright and crisp VGA displayed on one of the largest notebook screens in the industry. The display also features advanced fluorescent backlighting, 32 grey scales and 640 x 480 resolution. Plus, it can be adjusted to any position over a 135° angle and features easily adjustable brightness and contrast controls. Easy viewing under virtually any lighting conditions. You can connect to an external VGA color monitor too!

GREAT BATTERY FEATURES: Every battery feature you want. You can plug your notebook in and "quick charge" the battery in less than one hour or you can "trickle charge" while in use. Plus, your battery easily snaps out allowing the quick installation of an optional replacement battery. It's great to be able to carry a light weight spare for those especially long trips. An optional battery charger stand is available as well.

INTELLIGENT POWER MANAGEMENT: Your new ZEOS notebook features an intelligent programmable power management system if you wish to use it. Based on the length of time since your last keystroke, you may reduce CPU speed, display screen backlighting etc. Full power is immediately restored at the stroke of any key. The system even knows *not* to use the power management system when you are operating on AC power!

CHECK IT OUT!

Now, you can take desktop computing power anywhere! Your ZEOS notebook has many features of obvious importance. Also, there are a number of features that are subtle yet critical to your ultimate satisfaction. We'll go over them here one by one. We think you'll agree your new ZEOS Notebook is the one for you!

SYSTEMS STATUS AT A GLANCE: Yes, monitor eight key system components at a glance! We've equipped your new notebook with eight LED indicators which monitor disk access, keyboard functions and power status. There is even an audible alarm which may be programmed to inform you of a low battery condition and to let you know if the cover is closed with the power on. Now that's one smart notebook!

DESKTOP KEYBOARD FEATURES: We're talking 82 full size keys with full 101-key emulation. And the keyboard isn't squeezed either. The distance between the "Q" key and the "[" (left bracket) key measures 7.5 inches, just as PC Magazine suggests. The keys are of standard size, plus touch typists will love our full 3.5mm keystroke. Type for hours and love it!

CONNECTIVITY AND I/O: Keeping in touch is easy when you order our internal 2400 baud MNP Class 5 modem. Simply plug in the phone line and dial away. How about I/O ports? Many notebooks don't have them and if they do they're often non-standard. But your ZEOS notebook has *industry standard I/O*—serial, parallel and VGA. Just like your desktop!

FCC & UL APPROVALS: Your new ZEOS notebook features both FCC Class B and UL approvals. We've also met CSA and VDE requirements too, just for good measure. Quality and reliability.

WATCH THE DETAILS TOO: Like memory expandability. One Meg comes standard, you can also order a total of 3 or 5MB as a factory option. And lots of other details. Like a recessed power-on reset button, a soft carrying handle, built in speaker and more. You're going to love it! And there's no reason to wait.

CALL NOW TOLL-FREE:

800-423-5891

Your New ZEOS Notebook. Take your pick!

16 MHz '386SX Only $1995!

20 MHz '386SX Only $2295!

16 or 20 MHz, Hard Drive, Floppy Drive, VGA, 7 lbs., Beautiful!

Unbelieveable. Believe It!

Call Now! 800·423·5891

— NOW 16 OR 20MHz

t and ded.

Either way, you're sure to appreciate our light weight snap-in, snap-out battery packs. They're so light and easy to use, you can easily take an extra one with you on those really long trips. You can get even more life out of a single charge by using our programmable power management system. Hour upon hour of Notebook computing power!

CONNECTIVITY TOO!

Your new ZEOS notebook is a great connectivity tool. Utilizing our optional built-in 2400 baud MNP Class 5 modem, connectivity buffs will find themselves logging on at every turn. And speaking of connectivity, we've kept the I/O easy to use too. Because unlike many of the others, your new ZEOS notebook has the same industry standard port connectors you'll find on your larger desktop system. Completely compatible! Serial and Parallel ports; even an external VGA connector. All industry standard and ready to go the minute you receive your system.

It's attention to detail that makes the difference. Tens of thousands of hours of development time have been invested. We've been thinking and re-thinking exactly what you want in a notebook, and now we're building it for you. We think you'll agree, it's an incredible product. Plus, your new notebook is backed by the best support in the industry, 24 Hours a Day.

$1995!

ZEOS 24 HOUR A DAY SUPPORT.

After all, it was ZEOS that invented 24 Hour a Day Toll Free Sales and Technical Support. We're always here to help. Any time you need us your telephone is a Toll Free Hotline—direct to your own personal Technician. 24 Hours a Day, 365 Days a Year. Now that's ZEOS value. But we don't stop there either.

Your new notebook is also backed by our 30 Day Absolute Satisfaction Money Back Guarantee and One Full Year Limited Warranty. You're going to be very satisfied. We don't just say it. *We Guarantee It.*

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You can order your new ZEOS notebook *right now*. Simply pick up the phone and give us a call at 800-423-5891. And don't forget the extra goodies. Like larger hard drives, carrying cases, and extra batteries. All these are available now in money saving packages. You're going to love your ZEOS notebook. That's a guarantee!

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NOW. YOUR COMPLETE '386SX-16 NOTEBOOK! VGA, 20MB HARD DRIVE, 1.44MB FLOPPY AND MORE. LIGHT AND LOADED! INCREDIBLE.

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20MHz ONLY $2295!

- '386SX-16 or '386SX-20.
- 1MB DRAM, expandable to 3 or 5MB.
- 20MB High Speed HDD.
- Built in High Density 3.5" 1.44MB floppy drive.
- High Resolution VGA display. Fluorescent backlit 640x480, 32 grey scales. Bright and clear!
- Removable quick charge NiCad battery. Two hour plus battery life typical, more using Programmable Power Management!
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- 82 key keyboard. True 101 key emulation.
- Industry standard Serial and Parallel Ports.
- VGA port for external VGA color display. Great for demos!
- Total system weight seven pounds with battery!
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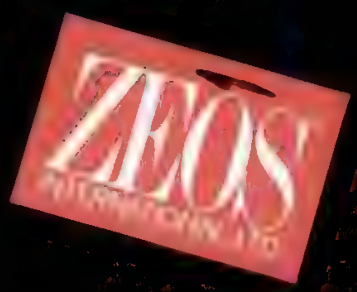

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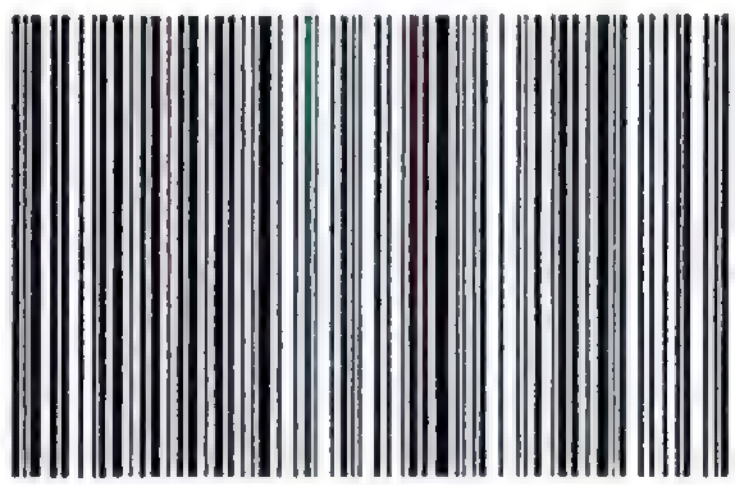
A few expert opinions:

"There's a new king of the hill–the ZEOS Notebook..." – PC Magazine, Editor's Choice ■ *"ZEOS' Notebook...it's the one to buy..."* – PC World, Best Buy ■ *"The ZEOS Notebook...a clear winner...why settle for less?"* – Byte ■ *"This notebook is a steal."* – InfoWorld ■ *"The ZEOS beats the Compaq."* – PC Computing ■ *"The ZEOS Notebook...delivers astonishing value...sensational."* – Portable Office ■ *"An outstanding value."* – PC Week

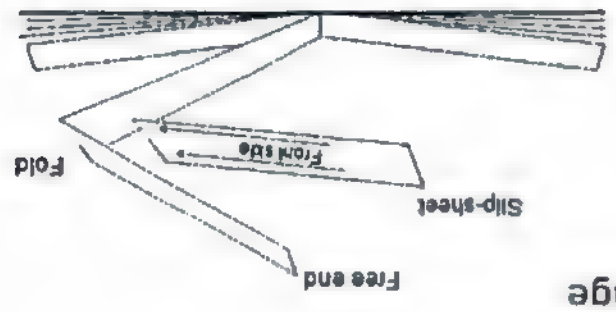
Outstanding Indeed! And The Price?

Folded edge of the page



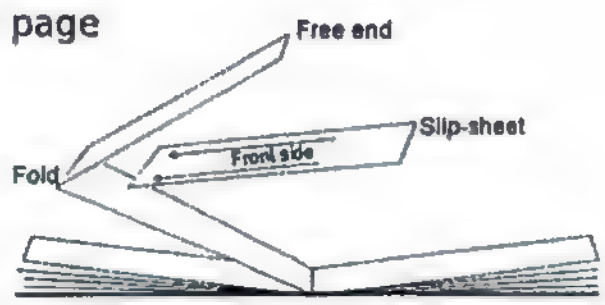
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



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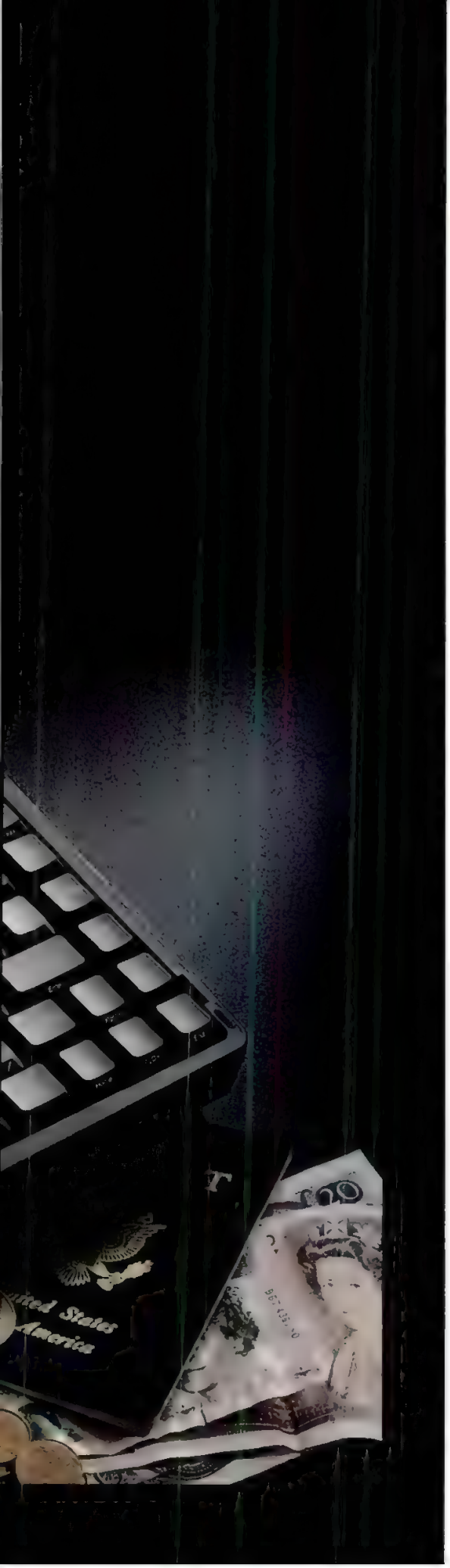
Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side



ZEOS NOTEBOOK 386

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PC MAGAZINE EDITOR'S CHOICE

PC WORLD BEST BUY

"THE HOTTEST DEAL ON THE NOTEBOOK MARKET"
—PC MAGAZINE, EDITOR'S CHOICE

"King of the Hill…Sensational…The best price-performer…Astonishing value …A steal…The number one contender…" We couldn't have said it better ourselves. Winner of PC Magazine's Editor's Choice Award and PC World's Best Buy Award, the experts love the ZEOS Notebook. And you'll love it too. At only $1995 for our '386SX-16MHz version and $2295 for our new 386SX-20, you simply can't find a better notebook anywhere!

As PC Magazine said, the ZEOS Notebook "offers a top notch combination of power, weight, features and price…" And you can pick your power! Choose our '386SX-16MHz version or go for the incredible new ZEOS '386SX-20MHz. Combine either with our high speed hard disk, built in 1.44MB floppy drive, VGA and more—you've got the greatest notebook going at any price!

INCREDIBLE DESKTOP FEATURES IN A NOTEBOOK.

In fact, it's really like owning a full featured desktop that you can take with you anywhere! Look closely at the details. Like our crisp 10" VGA display. The ultimate in sparkling clarity, it features advanced fluorescent backlighting for vivid VGA graphics. Then, the drives.

Two drives are better than one! First, your notebook will include our whisper quiet high speed, high capacity hard disk. It will read and write your data so fast chances are you'll hardly know it's there. Then we're building in an industry standard 1.44 Megabyte 3.5 inch floppy as well.

From

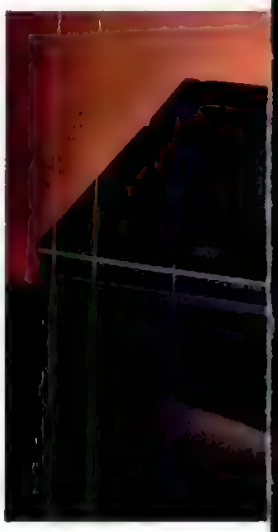
While most notebooks don't include a floppy drive at all, you're really going to appreciate your ZEOS notebook's industry standard 3.5" floppy. It makes loading software and transferring files a breeze. Simply toss in your 1.44 and it's done. Anyway, can you imagine a desktop system without a floppy? We couldn't either. That's why your ZEOS notebook has one. It's great!

But the features of your incredible new ZEOS Notebook don't just stop there. Detail after detail we're giving you more than anyone else. Much more, for much less. Take a closer look.

DETAILS MAKE THE DIFFERENCE!

For instance, the battery system of your new notebook is the most advanced on the market. You can quick charge, or trickle charge, any time your system is plugged in. You can also take the battery out and use the optional charging stand if you wish.

Now, you can
computing pov
The incredible Z



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ZEOS IS THE LEADER

10 Good Reasons To Buy From ZEOS®

Reason #1

"Overall Excellence."

As *PC Magazine* said "Price is always a consideration. So are benchmark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road."

These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but *eight* times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2

Dazzling Performance.

In one recent '386 review, *PC Magazine* awarded ZEOS Editor's Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world."

Dazzling Performance is built into every ZEOS system. It's a key component of ZEOS Overall Excellence.

Reason #3

Exceptional Quality.

PC Resource Magazine put it this way, "ZEOS... provides quality comparable with IBM or Compaq and does so for about 70% of the price." ZEOS uses only the very best components. And every system is fully tested and burned-in right in our own labs.

intel inside

Reason #4

Value.

InfoWorld says, "We find the ZEOS '386 an excellent value. Speed: Excellent. Compatibility: Excellent. Value: Excellent." *Personal Computing* said, "ZEOS... is the best value we've come across... its performance is right up there with the slickest, most expensive PCs you can buy."

24 HOURS!

Reason #5

Warranties and Guarantees.

ZEOS believes in its products. That's why we offer each and every customer our 30 Day Absolute Satisfaction Money Back Guarantee, no questions asked. Plus, our One Full Year Limited Warranty and Express Parts Replacement Policy. Optional On Site Service is available too. Call for details.

Reason #6

24 Hour Toll Free Technical and Sales Support.

At ZEOS, the customer is #1. That's why we invented 24 Hour a Day Tech Support. For *your* convenience. If you buy a product from us we feel we should be there to help, any time of the day or night. Give us a call Toll Free! 800-423-5891. Anytime!

Reason #7

Experience.

Almost unique in the mail order computer industry, ZEOS maintains its own chip level Research and Development staff. In addition to Systems Manufacturing, we also operate our own Board Level Manufacturing facility.

ZEOS has been involved in Research and Development since our incorporation back in 1981. Our strong and experienced Research, Manufacturing and Technical Staff translates into superior factory direct computer systems for you.

Reason #8

A Sterling Reputation.

In magazine after magazine and review after review ZEOS systems are cited for Overall Excellence, for Excellent Value, as the Right Choice and so on. All of this is flattering but the most important thing is this: What do our customers think? Frankly, they love us. The systems and the support. That means more to us than anything.

Reason #9

Easy to Buy.

ZEOS systems are easy to buy. You can pick up the phone any time of the day or night and order your new ZEOS computer. And we accept MasterCard, Visa, Discover, American Express, and Corporate Purchase Orders from Fortune 1000 Companies, Colleges, Universities and Governments. Complete Leasing Programs are available as well.

And now the Z•CARD! It's your very own ZEOS Credit Card and you can apply today. With the Z•CARD you can charge your ZEOS purchases and pay in easy monthly installments. It's just like a Bank Card. Why not apply for your Z•CARD now!

Reason #10

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Name _____

Home Phone (_____) _____

Soc. Sec. No. _____ Date of Birth ____/____/____

Address _____ Apt. _____

City _____ State _____ Zip _____

Since? (Mo./Yr.) _____ ☐ Buy ☐ Rent ☐ Other _____

Previous Address _____

City _____ State _____ Zip _____

Employer _____ Since? (Mo./Yr.) _____

Monthly Gross Salary $ _____ Daytime Bus. Phone (_____) _____

Previous Employer _____ From - To

Occupation _____

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_____ Relationship _____

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PLEASE TELL US IF YOU HAVE: Checking Account ☐ Yes ☐ No
Savings Account ☐ Yes ☐ No

	Y/N	How Many?		Y/N	How Many?
Bank Loan	___	_____	Dept. Store Charge Card	___	_____
VISA	___	_____	Credit Union Account	___	_____
MasterCard	___	_____	Other Major Charge Cards	___	_____
Finance Company Loan	___	_____			

C. JOINT APPLICANT INFORMATION

Joint Applicant's Name _____

Soc. Sec. No. _____ Date of Birth ____/____/____

Address _____ Apt. _____

City _____ State _____ Zip _____

Home Phone (_____) _____ Date of Residence _____ (Mo./Yr.)

Joint Applicant's Employer _____ Since? (Mo./Yr.) _____

Bus. Phone (_____) _____ Monthly Gross Salary $ _____

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Date _____

Joint Applicant's Signature _____

Date _____

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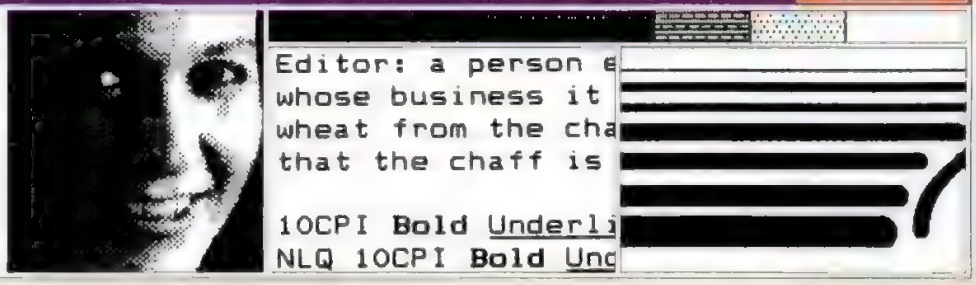
CIRCLE 115 ON READER SERVICE CARD

Tandy DMP 136 — $299.95

9-pin narrow-carriage dot matrix printer

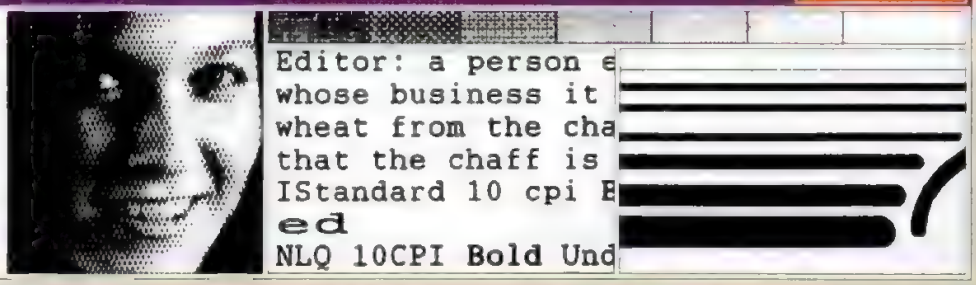
DRAFT TEXT SPEED 108 cps
LQ TEXT SPEED 30 cps
GRAPHICS SPEED: 1.1 gppm
GRAPHICS TIME 0 min. 52 sec.



Tandy DMP 202 — $399.95

24-pin narrow-carriage dot matrix printer

DRAFT TEXT SPEED 71 cps
LQ TEXT SPEED 29 cps
GRAPHICS SPEED 0.5 gppm
GRAPHICS TIME 2 min. 0 sec.

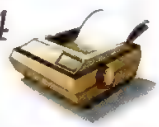


marketing for Epson America, claims that most printer buyers equate the cost of their printers with 25 to 35 percent of the cost of their PC systems. A $1,500 to $2,000 computer would then be accompanied by a $500 printer—directly within the dot matrix price arena.

So, while desktop printers may gradually lean toward the laser market, don't consider dot matrix printers extinct yet. There'll probably be one growling in your office habitat for some time to come.

BROTHER INTERNATIONAL CORP.

Brother M-1309
Brother M-1324



by Kellyn Betts

In these tight financial times, budget-conscious buyers will be interested to know that Brother International Corp. has vastly expanded its low-end dot matrix line by adding two narrow-carriage printers: the $299 18-pin Brother M-1309 and the $399 24-pin Brother M-1324.

In addition to having 6 more pins than its sibling (and a more expensive price tag), the 24-pin M-1324 provides an additional emulation, three extra typefaces, OCR-B, and far more speed. But that is where their differences end. Both printers—which are sold solely through retailers at street prices around $200 and $225, respectively—are housed in identical, sturdy cases made of plastic and attempt to address today's overriding price concerns.

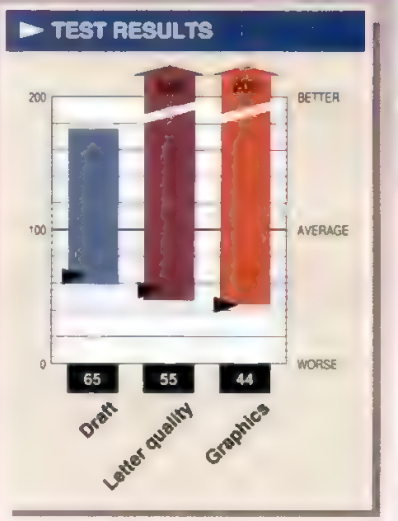
VERSATILE PAPER HANDLING

Printers this size need a pull tractor to scroll multipart forms past the platen. But users of single-part forms are rarely willing to put up with a pull tractor's paper wasting. Brother solves the problem by offering a continuous-form tractor that you can easily switch from its concealed, factory-standard push to a more visible pull position. Moving the tractor requires flicking a few switches and takes a minute, but it works equally well in both roles, and you can implement both printers' paper-loading and -parking features with the tractor in either position.

Another important paper-handling feature is unfortunately documented only in a reference manual Brother restricts to high-volume purchasers: the ability to reprogram the printer's default settings. Normally found only in more-expensive printers, this EEPROM programmability allows users to create and store alternative specifications such as custom form-size settings. Other users interested in the feature must have it described to them by the company's technical support department, which you can reach by dialing 800-284-4357. You use the menu mode to program the printer and set options. Because the printer communicates only with LEDs, it's a bit like using Morse code, especially since there is no printed dialog to confirm what you have set.

The menu settings also control the

Brother M-1309



18-pin scores

In Short: With respectable paper-handling options, the $299 18-pin narrow-carriage Brother M-1309's below-average performance and small typeface selection restrict it to the cost-conscious buyer.

type style, pitch, character set, and emulation options. The emulations that come with the M-1324 are notable because they may indicate the beginning of a new trend: In addition to its Epson LQ and IBM Proprinter emulations, the M-1324 comes with an NEC P2200XE driver.

MORE TYPESTYLE ON M-1324

If you need a broad assortment of typestyles, the M-1324 is the Brother of choice. Besides having seven type styles to the M-1309's four (including script and OCR-B), you can purchase an additional M-1324 font EEPROM for $79 with OCR-A, Quadro, Super Grande, and Symbol. Other enhancements are available for both printers, including 32K of additional RAM for $79, a serial interface for $89, and a 75-sheet single-bin sheet feeder for $179. The printers come with a one-year parts-and-labor warranty.

The output from both printers is good, though perhaps a trifle light. Brother made an effort to improve the printers' performance when they print at the edges of the paper, and it shows. Graphics can be a bit grainy, but letter-quality text produced by the 24-pin M-1324 is less fuzzy than that of the 18-pin M-1309. Though both models print text bidirectionally, the M-1324 is fast for a printer in its price category. Its letter-quality speed of 49 characters per second was noticeably faster than the 31-cps M-1309. The Brothers' draft scores were a little closer, with the M-1324 scoring 106 cps on PC Magazine Labs' text speed test and the M-1309 managing 105 cps.

Brother's new 1300 line is not its least expensive, though the M-1309's price equals that of the company's lowest-end printer, the 9-pin M-1109. The M-1309 and M-1324 continue Brother's tradition of offering competitively priced products, and compared with the other six dot matrix printers the company presently offers, both these printers score high in the price-and-performance equation. In September, Brother plans to beef up its high-end offerings by introducing the M-4309, which will be able to handle six-part forms up to 0.55 millimeters thick.

The new printer's rated speed in draft mode is 800 cps, and it will have nine resident typefaces and five bar-code patterns. Brother has not yet determined its price. In the meantime, if you're in the low-end market, the 1300 series is worth a glance.

FACT FILE

Brother International Corp., 200 Cottontail Ln., Somerset, NJ 08875; 908-356-8880.

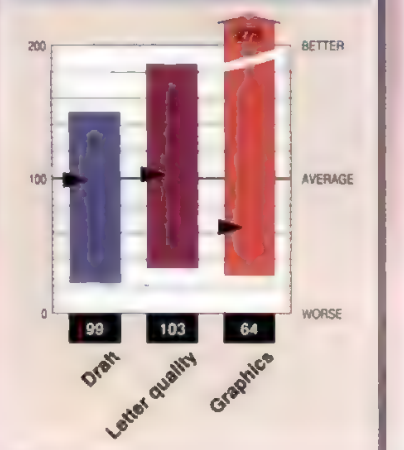
Brother M-1309
List Price: $299; RAM card, $79; 75-sheet cut-sheet feeder, $179; serial interface, $89.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 5 x 18 x 13 inches.
Weight: 11 lbs.
Emulations: Epson FX, IBM Proprinter.

Brother M-1324
List Price: $399; RAM card, $79; font chip, $79; 75-sheet cut-sheet feeder, $179; serial interface, $89.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 5 x 18 x 13 inches.
Weight: 11 lbs.
Emulations: Epson LQ, IBM Proprinter, NEC P2200XE.

CIRCLE 396 ON READER SERVICE CARD

Brother M-1324

TEST RESULTS



24-pin scores

In Short: Good paper-handling options, adequate speed, and a broad range of typeface selections make this $399 narrow-carriage printer a good buy. It is also one of the least expensive 24-pin units, with a street price around $225.

PRODUCT PHOTOGRAPHY: THOM O'CONNOR

BULL HN INFORMATION SYSTEMS INC.

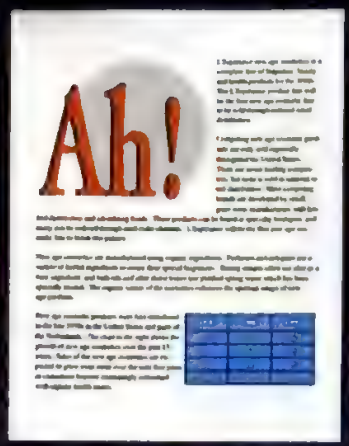
Bull Compuprint 970

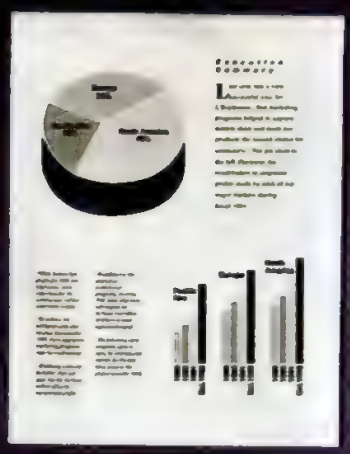
by Eric Berlin

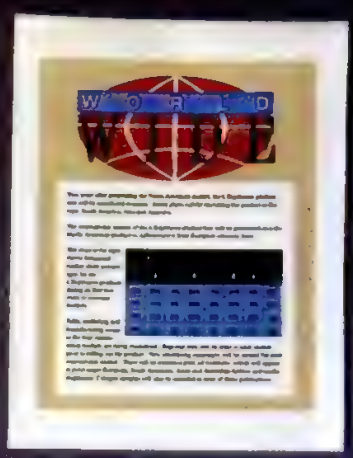
Here we have an example of design glitches and documentation problems sinking an otherwise promising printer. Printers from Bull HN Information Systems have always been designed for the business environment, and the $3,295 Bull Compuprint 970 is no exception.

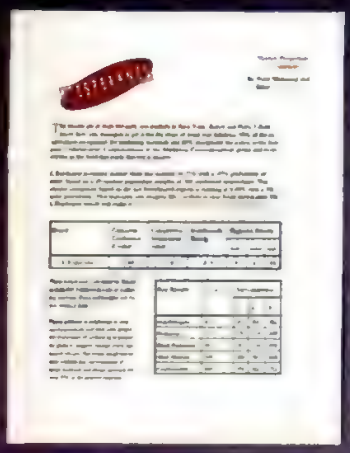
Faster and quieter than other printers in Bull's product line, the wide-carriage 18-pin Compuprint 970, rated at 300 lines per minute, is designed for heavy duty, forms-intensive jobs. Indeed, this 51-pound heavyweight can probably handle anything you throw at it. But while the Compuprint 970 has a fair number of features, accessing those features may be more trouble than it's worth.

The Compuprint 970 has a complex series of descending menus, which you









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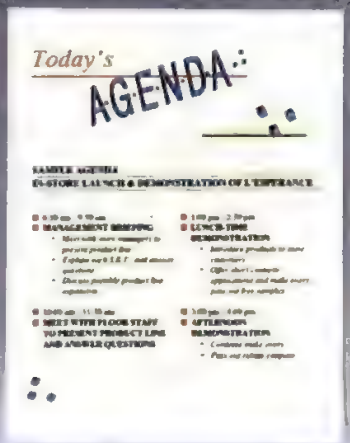

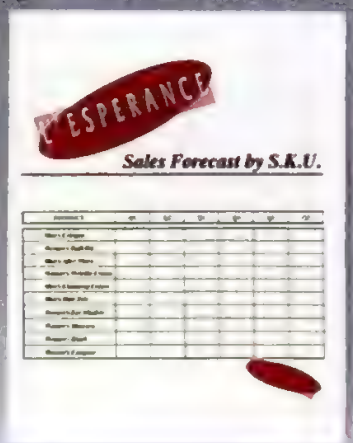

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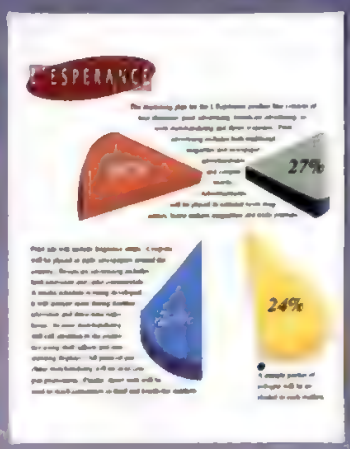

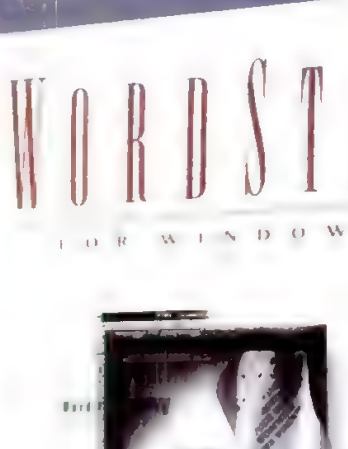

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CIRCLE 255 ON READER SERVICE CARD

EDITORS' CHOICE

- 9-pin: no standouts, no Editors' Choice
- 24-pin: Epson LQ-570, Epson LQ-870, Epson LQ-1170, and Panasonic KX-P2624
- Heavy-duty: Genicom 3840E and IBM 4226 Printer
- Line printer: Mannesmann Tally MT661
- Portable: Citizen PN48

More than half of the 47 dot matrix printers reviewed this year have list prices between $200 and $600. With low-end laser printers selling between $600 and $800, you should think twice about purchasing a dot matrix printer that costs more than $600 unless it has a special feature you truly need. For instance, if you need letter-quality wide-carriage spreadsheets, paying $900 for a wide-carriage 24-pin dot matrix is a much better deal than dishing out over $5,000 for a laser printer capable of handling B-size (11- by 17-inch) paper. And if your print jobs require multipart forms, why fork over the extra cash for a 24-pin printer when 9-pins are faster and can better handle thicker forms? Finding the lowest price for the features you need is the buying criterion for 1991.

LOW-END 9-PIN SIMILARITY

There is no low-end 9-pin printer that stands out enough this year to merit an Editors' Choice award. All of the 9-pin printers that we looked at showed a great deal of similarity, both in price and features. If this is your market, the best course of action may be to shop for the best price. For those of you with tight budgets, we liked two of the lowest-priced printers of this roundup: the 9-pin Star Micronics NX-1001 Multi-Font and the color-capable Star Micronics NX-1020 Rainbow, which have street prices around $126 and $170, respectively. However, in some cases 24-pin prices are falling dramatically; you might consider products such as the Brother M-1324 and the Panasonic KX-P1123, which you can find for $225 to $250, respectively.

24-PIN PRICE WARRIORS

As the prices of low-end laser printers continue to drop (you can find the 4-ppm HP LaserJet IIP for roughly $800, while Okidata's OkiLaser 400 can cost as little as $600), dot matrix vendors are trying harder,than ever to deliver products with unique features and lower prices. Market leaders Epson America and Panasonic Communications & Systems Co. have chosen different routes to achieve this end, one with scalable fonts, the other with a quiet mode.

This year, the narrow-carriage Epson LQ-870 and wide-carriage LQ-1170 have replaced Epson's highly successful LQ-850 and LQ-1050. Epson also introduced the midrange narrow-carriage LQ-570. All three new offspring sport the latest version of Epson's printer language, ESC/P2, which includes scalable fonts (but remember that although ESC/P2 works under *Microsoft Windows*, you cannot access its internal scalable fonts).

We weren't very impressed with either Epson's initial implementation of the scalable fonts nor the fonts' capabilities, but the LQ-570 has a competitive $499 price, while the LQ-870 and LQ-1170 list at the same price as their predecessors ($749 and $1,049, respectively); the new technology basically comes at no extra cost. And as befits the descendants of the three-time Editors' Choice–winning LQ line, these are all excellent and solidly built dot matrix machines with improved paper handling, an ergonomic case, and great performance (140 cps on PC Magazine Labs' text speed test in draft mode for the LQ-870 and LQ-1170, and 103 cps for the LQ-570). Naturally, the narrow-carriage Epsons are the more attractive desktop buy unless you truly need wide-carriage 24-pin capability.

Panasonic offers the only other improvement to impact technology for 1991: a quiet mode that's actually quiet. In addition to a new sound-dampening case, the Panasonic KX-P2624 uses a diamond-shaped printhead that fires the pins sequentially instead of simultaneously. Panasonic is able to rate the KX-P2624 at a whispery 43.5 dB—well below PC Labs' recommended maximum level of 60 dB. However, Panasonic compromises on performance: The KX-P2624 tested at only 55 cps in Super Quiet draft mode, compared with 111 cps with the quiet mode off. But Panasonic is offering the new technology along with high-quality output and fully featured wide-carriage 24-pin printing at a low $700 list price and an extremely low street price (around $450). All things considered, the KX-P2624 is one quiet printer that has tiptoed into the winners' box.

HEAVY-DUTY AND LINE PRINTERS

For heavy-duty data processing, multipart forms, or spreadsheet work on a limited budget, there is a market for rugged, fast printers at prices that tend toward the $2,000 to $3,000 range (rather than the $5,000 to $8,000 range of full-scale line printers). In this category, there were two outstanding machines in this year's roundup: the $2,595 18-pin Genicom 3840E and the $2,295 9-pin IBM 4226 Printer. Both printers distinguished themselves as high-end, workaholic 9-pin printers that are built to last; the Genicom is slightly more feature-rich (with more standard emulations, a high number of internal typefaces, and two simultaneously accessible paper paths as well as an optional paper shear), while the IBM printer performed a little faster (229 cps as opposed to the Genicom's 212 cps in draft mode).

For PC-compatible line printers, this year's winner by a wide margin is the $7,000 Mannesmann Tally MT661. This monster machine, rated at 800 lines per minute, flew through

PC Labs' standard text speed test at a blinding 674 lpm in draft mode—about twice the pace of the three other machines in its class (the CIE CI-250 LXP, CIE CI-500, and Printronix P3240). The MT661 is also full-featured, including OCR and bar-code printing options and a sound-dampening capability. If performance muscle is your need, this is the printer to buy.

PORTABLE WINNER

For portability, choose Citizen America Corp.'s tiny PN48. No bigger than a carton of cigarettes, the $469 PN48 is also *PC Magazine*'s choice as the best laptop printer of 1991. The other portable printers reviewed in this issue include the $1,295 Mannesmann Tally MT735 (a full-scale 6-ppm miniature page printer), the $499 24-pin Seikosha LT 20 (a standard though small 24-pin dot matrix printer), and the $499 Star Micronics StarJet SJ-48 (basically an ink jet–based clone of the Canon BJ-10e).

The PN48 weighs only about 3 pounds with its battery installed and runs on dot matrix thermal-fusion technology, allowing it to print with laser quality on almost any paper. It makes compromises in speed (24 cps in LQ mode and only 0.5 graphics pages per minute) and ribbon life (only 20 to 25 pages with the standard single-strike ribbons), and you have to hand-feed every sheet. But if you need to a print only a few pages while traveling and you don't want to lug around something that is as heavy and bulky as your laptop computer, the PN48 is the only solution. If you don't mind the weight and need a little more speed and paper-handling efficiency, take a look at last year's Editors' Choice winner, the $495 Canon BJ-10e (last reviewed in our October 15, 1991, issue). If you're in a real hurry for fast laser-quality laptop printing, however, your only choice is this year's Mannesmann Tally MT735.

manipulate through the six-button front control panel and an 80-character LCD. Finding your way through these menus requires experimentation and a little luck. For instance, if you want to change the emulation, you could press buttons long into the night before realizing that you can do it only by using an entirely separate setup procedure at the printer's start-up. The documentation mentions this only briefly, and the lack of an index makes the manual exceedingly difficult to use. A company spokesperson claimed that the next version of the documentation will show many improvements.

When you do get your Compuprint 970 running to your satisfaction, you will find a speedy workhorse at your service—albeit one with a hefty 7- by 25- by 17-inch case. In draft mode, the Compuprint 970 generated an impressive 284 characters per second in its IBM Proprinter emulation—the fastest of any 9- or 18-pin dot matrix printer reviewed this year. Likewise, in letter-quality mode, the Compuprint 970 claimed the 9- and 18-pin checkered flag by chugging out 131 cps. When printing graphics, you will want to keep the Compuprint 970 in its speedy IBM Proprinter emulation, which lets you print 3.3 graphics pages per minute. The Compuprint 970 has only three resident fonts—Courier, OCR-B, and a Bull original called Fast—but a cartridge supplying eight additional fonts is available for $50. A large number of emulations are supplied with this printer, however, including Epson DFX, Epson FX, Epson JX, IBM Graphics Printer, and IBM Proprinter.

Paper-handling options are a little limited, but those that exist work well enough, whether for form or sheet feeding. The printer has bottom and rear feeds for continuous-form paper, or you can front-feed single sheets. Most of the paper-handling commands are entered via the control panel; this is one area where the LCD is fairly self-explanatory. To feed in single sheets, you must first open the front cover. Unfortunately, this cover is difficult to unlatch, and once opened, it may come off in your hand. You'd be better off using the automatic sheet feeder. This pricey option comes in two bins, and while each bin holds 130 sheets, the one you must buy first costs $649 and contains a motor needed to operate the $445 second bin. Though these bins add bulk to an

Bull Compuprint 970

already sizable printer, their set up and use are fairly painless.

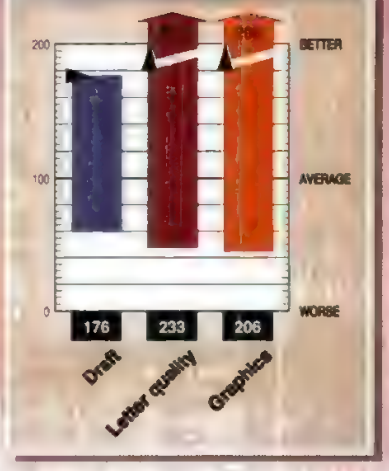
As high-end 9-pin printers go, the Compuprint 970 makes only a half-hearted attempt at the price-versus-speed equation, and it also loses points for sparse features and a maladroit design. If you need speed as well as a wide selection of resident fonts and a little less complexity, you will have to look elsewhere.

FACT FILE

Bull HN Information Systems Inc., Technology Park, Billerica, MA 01821; 508-294-6600.
Bull Compuprint 970
List Price: $3,295; eight-font cartridge,

Bull Compuprint 970

TEST RESULTS



18-pin scores

In Short: The $3,295 wide-carriage Bull Compuprint 970 is an ultrafast 18-pin printer. Its impressive text and graphics speeds are marred by a complicated control panel and poor documentation.

$50; motorized 130-sheet cut-sheet feeder, $649; nonmotorized 130-sheet second sheet feeder, $445.
Standard Warranty: One year on parts and labor.
Dimensions: 7 x 25 x 17 inches.
Weight: 51 lbs.
Emulations: Epson DFX, Epson FX, Epson JX, IBM Graphics Printer, IBM Proprinter.

CIRCLE 397 ON READER SERVICE CARD

CIE AMERICA INC.

CIE CI-250 LXP
CIE CI-500

by John R. Quain

CIE America's $2,295 18-pin CI-250 LXP dot matrix printer and $5,895 34-pin CI-500 line printer are the Volvos of multiuser printing. They are sturdy and have wide carriages, rugged tractor feeds, convenient but square designs, and healthy speeds of up to 257 characters per second. Both models include IBM Proprinter and Printronix line-printer emulations, so they can handle most computing terrains. However, like the Volvo, they don't offer a lot of style; there are only two primary fonts, Courier and sans serif, and dealer prices run only around 15 percent below the suggested list price.

Both models have a seven-button control panel, a 15-character LCD, a Centronics parallel port, and an RS-232C port (or free RS-422 option). To accommodate networks and workgroups, both models also have four storable user settings, which you can configure with instructions for individual print jobs. As soon as they are stored, you can recall the settings remotely or through the control panel. The CI-500 also has a fifth "scratch" setting for special parameters that you don't want to store.

CIE CI-250 LXP

CHIP OFF THE OL' CI-1000

On the outside, the CI-500 is the spitting image of the $9,995 CI-1000 we featured in *PC Magazine*'s special printer issue last year (November 13, 1990). The CI-500, though, is a low-end version of its forebear. Inside, it has half as many print wires (34 pins mounted on a rod-and-cam shuttle mechanism), runs a little more than half as fast (rated for 540 lines per minute versus the CI-1000's 940 lpm), and costs only a little more than half as much. But like its pricier parent, the CI-500 is a true line printer designed to handle heavy loads—up to 100-pound paper stock and six-part forms. The printer (with stand) is only 13 by 28 by 20 inches, but it tips the scales at 110 pounds, and with the optional $1,200 sound-dampening stand, it rises 42 inches off the floor. The CI-500 contains 8K of buffer memory, with no memory upgrade available.

The printer feeds continuous-form paper through the bottom and kicks it out the back with a push/pull tractor. Loading the dual-spool ribbon is a plastic-gloves operation, but once you are done, there is little need to lift the hood again. The control panel allows you to align paper or park it without lifting the cover.

In addition to its two primary emulations, the CI-500 contains CIE's own line-printer emulations, and a $1,200 QMS emulation option is available. To hook up to IBM minis, CIE offers coaxial- or twinaxial-cable interface options for $1,200 each. Bar-code and forms generation is part of the standard package. There are two primary fonts—sans serif and Courier—but the printer is equipped to produce OCR-A and OCR-B for optical character readers. Text settings include draft, high-speed draft, near letter quality, and letter quality.

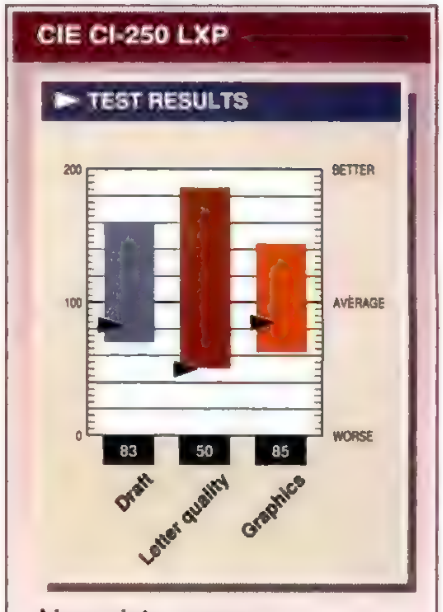
The floor-shaking speed of the CI-500 comes from its high-speed draft (HSD) mode. On PC Magazine Labs' tests, the CI-500 cranked out 257 cps under its IBM Proprinter emulation in a standard draft mode of 10 characters per inch. LQ output at 10 cpi in IBM mode is only 83 cps, but the type is crisper than most line-printer output, if a little cramped.

WHEN IS A LINE PRINTER NOT A LINE PRINTER?

The $2,295 CI-250 LXP is designed much like the CI-500, save for one important difference: It is not a line printer. As a dot matrix printer, the CI-250 LXP creates one character at a time rather than printing an entire line at once.

Using a belt-driven 18-wire system and standing about 5 inches lower than the CI-500, the CI-250 LXP is not as rugged as its more expensive relative. But what it lacks in strength it makes up for in flexibility. You can feed fanfold paper with the push/pull tractors at the bottom or back of the printer; it can eject the paper out of the top or the back. A pressure-feed setting will accommodate envelopes or hand-fed cut sheets (though a sheet-feed option would be preferable). And there is a $149 color option that includes a color motor and positioning bar; color ribbons are not cheap, at $49 each.

Even though the CI-250 LXP is not a true line printer, it can accommodate mini- or mainframe computers by using an included line-printer emulation cartridge. The cartridge translates microcode intended for CIE and Printronix line printers. (In addition to the IBM emulation, there is an Epson FX emulation for PC users.) Businesses that are looking to lessen the impact of postal rates will



Line-printer scores

In Short: With poor speed but a decent feature selection, the $2,295 CIE CI-250 LXP is still a viable choice as a high-end line printer. But faster printers are out there.

also appreciate the cartridge's Postnet bar codes—the U.S. Postal Service's bar-code system.

In addition to the print modes also offered by the CI-500, the CI-250 LXP

CIE CI-500

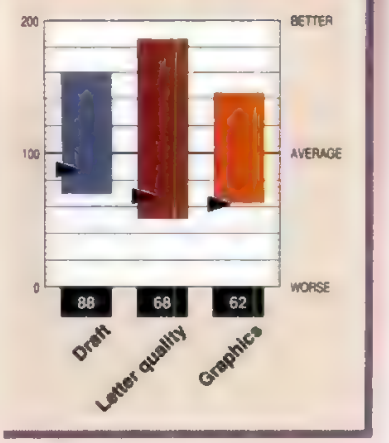
includes a memo and a half-speed quiet mode. Maximum graphics resolution is rated at 240 by 216 dots per inch, and average text throughput is rated to exceed 300 lines per minute, according to the manufacturer. In line-printer mode (CI-DTP emulation at 10 cpi), the type is obviously draft quality: It is light, and there is noticeable space between the dots. The IBM emulation takes a speed penalty; the C-250 LXP produced 242 cps in draft mode and only 61 cps at 10 cpi in LQ mode. The thin serif Courier face in LQ mode is relatively clean, allowing for readable 12-cpi printing when necessary.

CIE offers a number of options for the CI-250 LXP, including a pedestal for $165 and a 64K memory upgrade for $149 (base-priced memory is 8K). However, there are no font-cartridge options or bin-sheet feeders available as yet for either printer. CIE was unable to state when these would be available.

Both the CIE CI-250 LXP and the CI-500 printers come with one-year parts-and-labor warranties and thick user manuals. Both printers mean business, as their no-nonsense features and design suggest. If you are considering a line printer for continuous network printing tasks, you'll discover that these two CIE printers are easier to use than most, and their speeds and prices are competitive.

CIE CI-500

TEST RESULTS



Line-printer scores

In Short: The $5,895 CIE CI-500 is a fine line printer (the second-fastest reviewed), but in a printing drag race it was flat-out clobbered by the slightly more expensive Mannesmann Tally MT661.

FACT FILE

CIE America Inc., 2515 McCabe Way, P.O. Box 19663, Irvine, CA 92713-9663; 800-877-1421, 714-660-1421.

CIE CI-250 LXP

List Price: $2,295; 64K memory upgrade, $149; color option, $149; color ribbon, $49; pedestal, $165.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 7 x 24 x 23 inches.
Weight: 33 lbs.
Emulations: CI-DTP, DEC series, Epson FX, IBM Proprinter, Printronix P6000.

CIE CI-500

List Price: $5,895; QMS Magnum emulation, $1,200; soundproofing cabinet, $1,200; zero-inch tear-off access cover, $175; coaxial and twinaxial interfaces, $1,200 each.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 13 x 28 x 20 inches (with stand).
Weight: 110 lbs. (with stand).
Emulations: CI-DTP, CI-400/800, IBM Proprinter, Printronix P6000.

CIRCLE 396 ON READER SERVICE CARD

CITIZEN AMERICA CORP.

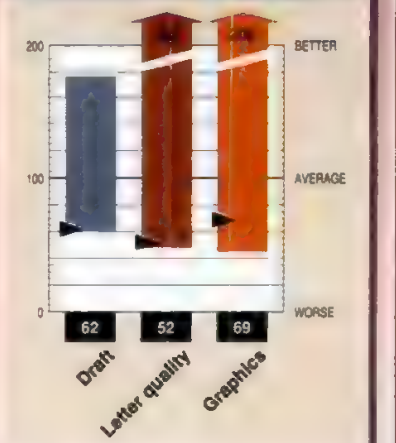
Citizen 200GX Fifteen
Citizen GSX-130
Citizen GSX-140 Plus
Citizen GSX-145
Citizen PN48

by Winn L. Rosch

It makes sense that Citizen America Corp. was at one time a subsidiary of Japan's Citizen Watch Co. Like high-quality, jewel-movement watches, the printers in Citizen's new line of dot matrix machines rely on precision for their market edge. They do exacting work, producing superb graphics output within the limits of their technology. The five-member 1991 collection improves on previous Citizen printers, filling in gaps in a wide dot matrix product line (with the $499 9-pin wide-carriage 200GX Fifteen, the $399 24-pin narrow-carriage GSX-130, the $499 24-pin narrow-carriage GSX-140 Plus, and the $649 24-pin wide-carriage GSX-145) and also adding a delightful alternative for the laptop computer (with the 2-pound laser-quality $469 PN48).

Citizen 200GX Fifteen

TEST RESULTS



9-pin scores

In Short: A 9-pin wide-carriage printer, the $499 Citizen 200GX Fifteen combines quality, options, and price with an easy-to-understand control panel.

DESKTOP SIMILARITIES

Despite their variations in speed, quality, and cost, the four desktop Citizen printers (the $499 200GX Fifteen, the $399 GSX-130, the $499 GSX-140 Plus, and the $649 GSX-145) all share the same basic mechanism: a traditional belt-driven design with a tiny printhead (about 1.5 inches square) driven by substantive cogged belts across the guidance of a heavy chromed tube. Also common to all four Citizen desktop printers is the ability to add color with the addition of an inexpensive "Color on Command" kit ($59 for narrow-carriage and $79 for wide-carriage models). The same hardware fits all Citizen desktop printers and works by simply adding a means of shifting among four ribbon hues. When printing graphics, each printer produced output much faster in Epson emulations than IBM mode, thanks to excess printhead motion in the latter.

Each model's printhead chamber is lidded by a double-hinged plastic cover, which serves the twin purposes of keeping noise inside and directing paper along the correct path. Unfortunately, the pieces don't seem to fit together very well at times, and they come apart too easily.

The basic Citizen paper-handling scheme is pressure-feed based on a conventional large rubber platen roller, which is connected to a hefty knob on the right side of the case for manual paper positioning. Single sheets feed conventionally through to the top, typewriter-style, or automatically through an optional 100-sheet single-bin cut-sheet feeder, which lists for $239 for wide-carriage mechanisms and $169 for narrow carriages.

For continuous-form paper, the Citizen mechanism gives you two alternatives: rear or bottom feed, thanks to a dual-purpose tractor. Press two tabs on the tractor in its default internal push position and it lifts out, allowing you to install it as a pull tractor on top of the platen. You will probably prefer the former arrangement because it allows the Citizen mechanism to park the continuous paper on command, so you can load individual sheets or envelopes without messing with the tractors.

All the desktop Citizen printers also share the same basic cable layout with a nonremovable grounded (three-wire) power cable on the left, near the power switch at the case's rear left corner. The signal cable plugs into the Centronics-style connector of the standard-equipment parallel port on the right. A snap-in module adds an optional serial port capable of communicating at data rates up to 9,600 bits per second.

THE 200GX FIFTEEN AND THE GSX-130

The lower-end $499 9-pin wide-carriage 200GX Fifteen and $399 24-pin narrow-carriage GSX-130 are differentiated not only by lower prices but also by a clever two-stage mechanical menu system. Four push buttons (flush switches on the 200GX Fifteen, raised tabs on the GSX-130) each perform four functions because of a sliding menu tab that alters the labels of each key. In one position, for example, the four buttons work the standard control functions (form-feed, on-line, and so on), and in another position they allow you to select the font or pitch. The plain-English legends and logical grouping of these controls make them intuitive and easy to use. On these printers, the 16 push-button functions are complemented by setup DIP switches, hidden near the parallel port, for making such "set-once" adjustments as serial-port parameters and emulations.

As far as typefaces go, the 200GX Fifteen adds only draft and high-speed draft to the expected Courier, sans serif, and Times Roman fonts. The GSX-130 adds Prestige. On PC Magazine Labs' text speed test, the 200GX Fifteen managed 100 cps in its IBM Proprinter draft mode (although it has a slightly faster high-speed draft mode) and only 29 cps in letter-quality mode. The GSX-130 managed 127 cps in its IBM Proprinter draft mode and moved along nicely at 55 cps in LQ mode, thanks to its 24 wires.

In graphics mode, the Citizens' IBM emulation proved substantially slower than their Epson emulation: The printhead would move several inches and then back up before continuing. Since there was no qualitative difference between the two emulations, you will want to make the Citizen machines think they came from Epson.

THE GSX-140 PLUS AND THE GSX-145

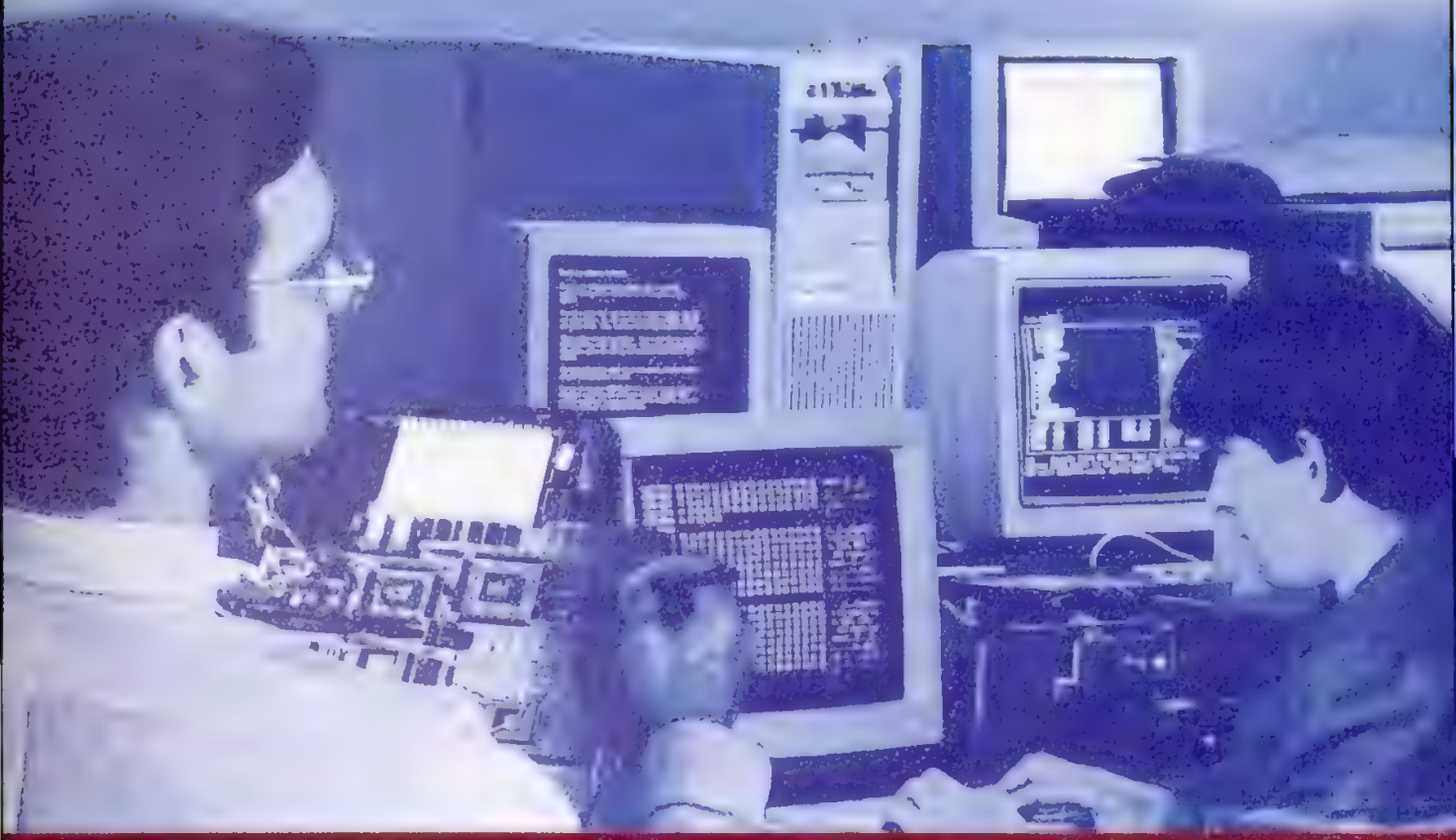
The $499 24-pin narrow-carriage GSX-140 Plus and $649 24-pin wide-carriage GSX-145 use Citizen's more-advanced controls: an electronic menu system based on an eight- by two-character LCD. Once you get the hang of it, the controls are easy to manipulate. Citizen allows four macro menu settings, which essentially allow you to define four completely different printers (each with its own emulation, type pitch, font, and page layout); each is selectable as a single menu choice. Because the printers' default settings are adjusted as a macro, setup is a bit more complex than that of other printers that remember everything automatically. But the virtue of flexibility should outweigh the bother for most people.

In terms of on-paper work, these 24-

Why Is Northgate® Going Public
With Confidential Information?

CIRCLE 194 ON READER SERVICE CARD

To Illustrate The Northgate



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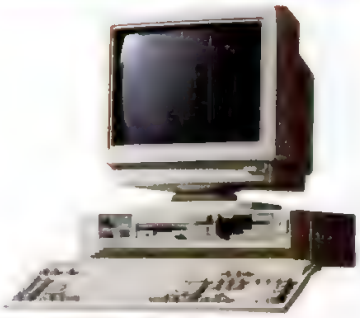

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CIRCLE 368 ON READER SERVICE CARD

CODE A1420

pin machines are limited for the most part by the fuzziness of the fabric ribbons in their harmonica-style cartridges. Text output meets today's definition of dot matrix near-letter quality by at least equalling typewriters of days gone by. On PC Magazine Labs' text speed test, the GSX-140 Plus beat all the other Citizens by achieving 112 cps in IBM Proprinter draft mode, while producing 53 cps in its LQ mode. The GSX-145 managed only 100 cps in its IBM Proprinter draft mode (though like the GSX-140 Plus, it has a slightly faster high-speed draft mode) and 48 cps in LQ mode. The GSX-145 contains the traditional Courier, sans serif, and Times Roman, and it also adds Prestige; the GSX-140 Plus throws in Orator and script as well.

In printing graphics, output was good but still showed its dot matrix origins. Sometimes (and this applies to all four Citizen desktop machines) the paper feeding was a bit generous, resulting in slight gaps: Thin lines of white showed between printhead passes on dark backgrounds.

THE TINY CITIZEN PN48

Citizen calls its remarkable $469 PN48 a "notebook" printer because it is designed to accompany notebook and laptop computers, not because it looks like one. Weighing 2 pounds without its half-pound nickel cadmium battery installed and measuring 2 by 12 by 4 inches, this printer is about the size of a carton of cigarettes, easily able to fit at the bottom of anyone's attaché case along with extra work *and* a laptop PC.

Portable printers may be nothing new, but the print quality the PN48 offers is. Rightly claimed by Citizen to be laser-quality, the PN48 delivers a resolution of 360 dots per inch that fully lives up to the company's boast. Using thermal fusion technology, it prints absolutely black blacks on plain paper by using the heat of its 48-element printhead to melt special inks in place from single-strike or multi-strike ribbons.

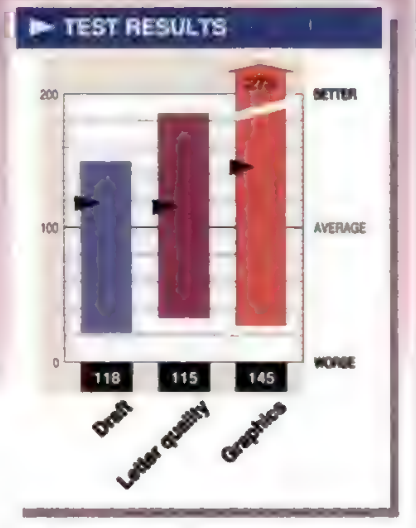
Certainly the PN48 makes compromises. It is not particularly fast, scoring a mediocre 0.5 graphics pages per minute under its IBM Proprinter emulation on PC Magazine Labs' graphics speed test, and it scored a dismal 24 characters per second on the standard text speed test. Draft and top-quality printing run at the same speed.

Another compromise is ribbon life—a claimed 20 to 25 pages with the single-strike ribbon and 50 to 70 pages with the ASCII ribbon, which we confirmed during testing. (Then again, the single-strike ribbon lasts for almost exactly one battery charge, which is rated at 25 pages.) The PN48's paper handling gives you but one choice, friction feed, although you can feed paper from the bottom or back of the printer. The single-choice mechanism will handle paper widths up to 10 inches on 28-pound stock. Its thermal-based mechanism will not, however, make carbon copies. It emulates Epson LQ and IBM 24-pin printers (HP PCL would be a welcome addition) and comes with two built-in fonts, Courier and Times Roman, in sizes from 2.8 to 20 characters per inch.

The PN48's control panel, located at the front right corner, includes a rudimentary menu system that uses a single-character LED and three push buttons. Instructions for using the system are summarized under the hinged cover. A DIP switch hidden inside is used primarily for initial setup, such as setting print emulations. In addition, the PN48 has a thumbwheel for setting the darkness of its printing, along with an on/off switch and an LED on the control panel that indicates battery life.

The PN48 uses a miniature Centronics connection for its parallel input; a matching 18-inch cable terminates in an IBM-

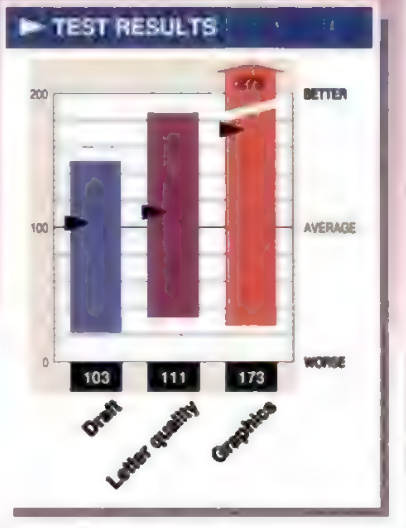
Citizen GSX-130



24-pin scores

In Short: The $399 24-pin narrow-carriage Citizen GSX-130 combines an elegant and understandable control panel, a color option, and moderate speed and print quality. The result is a well-rounded printer.

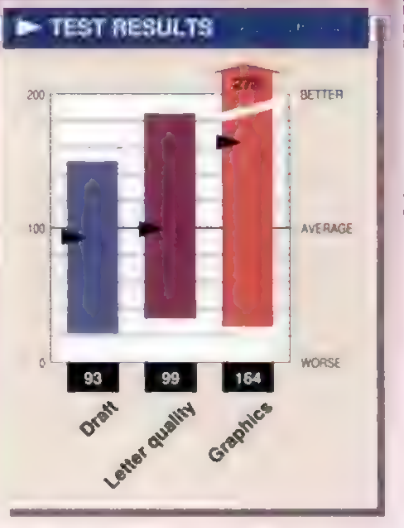
Citizen GSX-140 Plus



24-pin scores

In Short: The $499 24-pin narrow-carriage Citizen GSX-140 Plus is a quick performer with elaborate controls and extensive typefaces.

Citizen GSX-145



24-pin scores

In Short: The $649 24-pin wide-carriage Citizen GSX-145 turned in good performance scores and graphics quality.

style 25-pin D-shell connector and is included with the printer. This seems a nifty solution until you lose the cable, at which point it will cost you $42 to order another from Citizen.

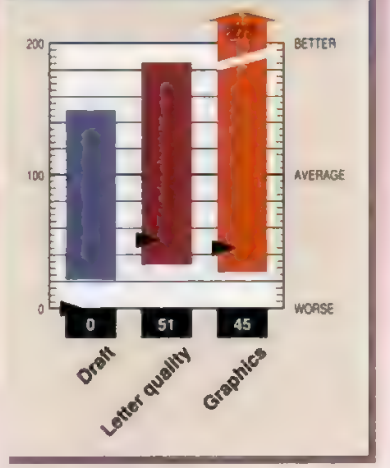
The PN48 comes with a narrow spiral-bound pamphlet that includes enough information for getting the printer running, but reference information (such as programming the typeface selection) is included in a hypertext-style program on a 3.5-inch floppy disk. There is also a nifty Professional Package ($549) that includes a battery, two ribbon cartridges, and a carrying case.

The desktop impact printers are all covered by Citizen's two-year parts-and-labor warranty. The PN48 carries a standard one-year parts-and-labor deal, but for $19.95 you can enroll in the Executive Plan, which will get you a replacement unit within 24 hours anywhere in the continental United States and Canada for one year. Raising that to $69.95 gets you the Extended Executive plan, which lasts for two years.

Citizen's impact dot matrix machines are competitive in features, performance, and price; they are worth looking at if you are in that market. The PN48 is a design star and may be the most perfect laptop printer yet.

Citizen PN48

TEST RESULTS



24-pin scores

In Short: Although battery and ribbon life are brief, the tiny and amazing portable $469 48-cell narrow-carriage Citizen PN48 is a top choice for those who don't mind waiting for some of the best print quality on the road today.

FACT FILE

Citizen America Corp., 2450 Broadway, #600, P.O. Box 4003, Santa Monica, CA 90411-4003; 213-453-0614.

Citizen 200GX Fifteen
List Price: $499; 100-sheet cut-sheet feeder, $239; color option, $79; serial interface, $49.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 5 x 23 x 13 inches.
Weight: 17 lbs.
Emulations: Epson FX, IBM Proprinter.

Citizen GSX-130
List Price: $399; 32K RAM upgrade, $69; 100-sheet cut-sheet feeder, $169; color option, $59; serial interface, $49.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 5 x 16 x 13 inches.
Weight: 12 lbs.
Emulations: Citizen GSX, Epson LQ, IBM Proprinter.

Citizen GSX-140 Plus
List Price: $499; 32K RAM upgrade, $69; 100-sheet cut-sheet feeder, $169; color option, $59; serial interface, $49.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 5 x 16 x 13 inches.
Weight: 12 lbs.
Emulations: Citizen GSX, Epson LQ, IBM Proprinter.

Citizen GSX-145
List Price: $649; 32K RAM upgrade, $69; 100-sheet cut-sheet feeder, $239; color option, $79; serial interface, $49.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 6 x 23 x 13 inches.
Weight: 17 lbs.
Emulations: Citizen GSX, Epson LQ, IBM Proprinter.

EDITORS' CHOICE

Citizen PN48
List Price: For standard model, with one ribbon cartridge and AC adapter, $469; Professional Package (with battery, two ribbon cartridges, carrying case), $549; extra cable, $42.
Standard Warranty: One year on parts and labor; one-year Executive Plan, $19.95; two-year Extended Executive plan, $69.95.
Dimensions (HWD): 2 x 12 x 4 inches.
Weight: 2 lbs. (without battery); 3 lbs. (with battery).
Emulations: Citizen GSX, Epson LQ, IBM Proprinter.

CIRCLE 399 ON READER SERVICE CARD

DATASOUTH COMPUTER CORP.

Datasouth Performax
Datasouth XL-300

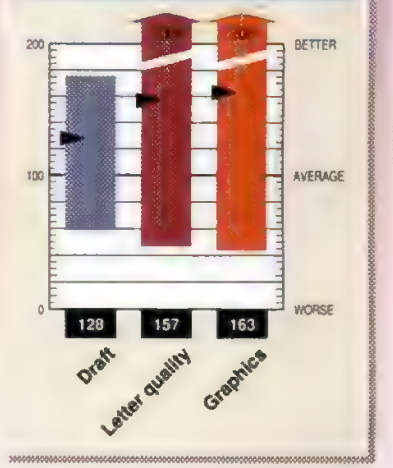
by Kellyn Betts

Cresting both the price and speed wave for desktop dot matrix printers, Datasouth's $2,995 18-pin Performax and $1,595 9-pin XL-300 are a tough and rugged pair. Mini- and mainframe-computer associations aside, their function for PC users is to churn out thick multipart forms and long reports swiftly and continuously.

For 14 years, Datasouth has specialized in printers that are sturdy, robust machines with high duty cycles and thick-form printing abilities. While the company's minicomputer and mainframe origins are still apparent (besides a DEC LA-120 emulation, these printers have coaxial and twinaxial interface options),

Datasouth Performax

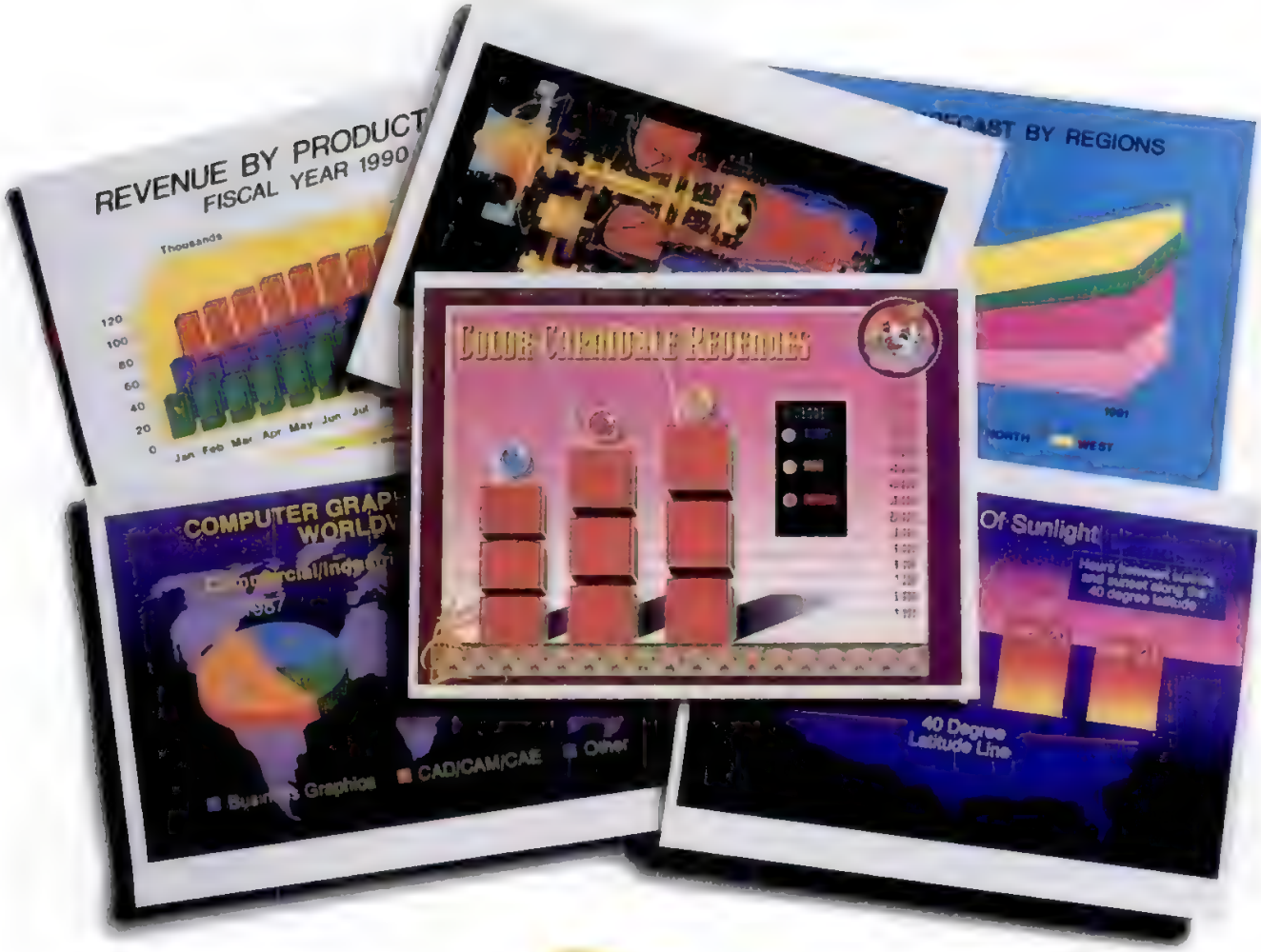
TEST RESULTS



18-pin scores

In Short: Housed in a surprisingly compact package, the $2,995 wide-carriage Datasouth Performax is a heavy-duty ultrafast 18-pin printer with comprehensive paper-handling options.

Great Output.



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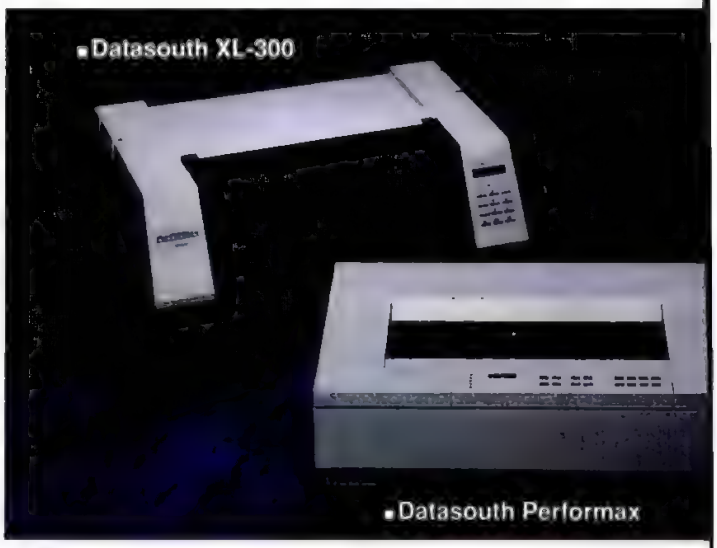
their PC-compatible emulations (Epson and IBM Proprinter, in the Performax's case) trumpet the company's desire to broaden its appeal to users of PCs linked by networks and multiuser Unix systems.

the Performax's noisy operation is compensated for by excellent performance.

Datasouth's PC-oriented line includes a third printer, the 9-pin XL-400. All three have wide carriages and are sold via a two-tiered distribution channel through which end users may be able to find the Performax for as low as $2,200 and the XL-300 for a competitive $1,250.

THE PERFORMAX

When the Performax is in its fast-draft mode, it sounds like a washing machine during the spin cycle. But its noisy operation is compensated for by excellent performance. On PC Magazine Labs' text speed test, it zoomed along at 207 characters per second in IBM Proprinter draft mode (and there is also a faster high-speed draft mode), the continuous-form paper quaking as it was pushed past the printhead from the straight bottom-feed paper path. (The push mechanism is unusual for a printer of this type; the paper is tightly pressed against the aluminum platen by a pair of rubber-coated metal rollers.) The Performax also offers two letter-quality typefaces: Courier at 10 characters per inch and Prestige at 12 cpi. The LQ typefaces are much denser than draft, and when printing in Courier, the Performax delivered a speed of 88 cps in the IBM Proprinter emulation.



Considering how fast it operates in draft mode, we found the Performax surprisingly small, at 9 by 26 by 18 inches and 47 pounds. Printers with similar speeds and duty cycles (its printhead alone has a rated life of 300 million characters) are usually housed in monstrous metal cases to muffle their sound and vibration. You would not want this printer on your desk, but its rated 62-dB sound level is low, given its throughput level. If you don't mind a speed penalty, you can reduce the noise to a slightly more bearable 59 dB by enabling the printer's quiet mode.

You can select and specify a host of other options through the Performax's 32-character LCD when the printer is in setup mode. Being able to select one of four emulations is just the tip of the iceberg. For example, you can specify the vertical pitch for printing text, from 1 to 12 lines per inch, and even the distance the printer needs to move continuous forms so you can tear them off in 0.01-inch increments. You can save up to four profiles, each with different values for 40 excruciatingly detailed user-selectable features. After configuration, this makes it easy to use one printer to produce inventory tickets and nine-part invoice forms.

The $3,295 version we tested was outfitted with an internal cut-sheet feeder. This option must be installed at the factory and provides the printer with an additional door for single sheets. An internal mechanism grabs the paper and straightens it out as it feeds toward the printhead. Both paper parking and cut-sheet feeding are executed from the front panel.

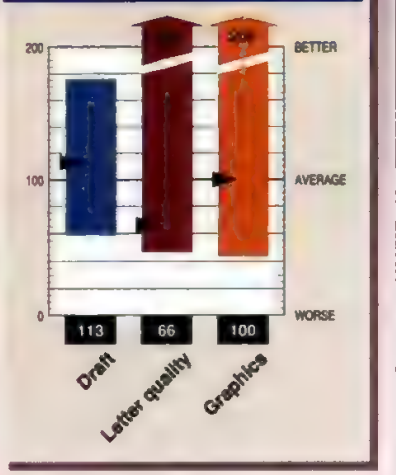
THE XL-300

Compared with the feature-laden Performax, the Datasouth XL-300 is austere. It has but one nameless resident type style, which you can print at 10 pitch near-letter quality and a number of other pitches in draft. Its emulations are of the Datasouth DS-180, the old DEC LA-120, and the Epson FX.

The DS-180 emulation is the key to explaining the XL-300's peculiarities. In reality, the XL-300 is the mechanical equivalent of the seven-year-old DS-180, which was long the mainstay of Datasouth's line. The new, faster printhead and engine are the most important differences separating the XL-300 from its predecessor. While the unit is much more programmable than many other printers, the XL-300's three-character LCD shows only numeric codes, which require you to wade through an erratic and laconic manual. The printer was not able to generate subscripts or superscripts when we tested it in Epson FX mode, though it performed adequately on our text speed test—184 cps in draft and only 37 cps in LQ mode under the Datasouth XL-180 emulation. Speed is not the reason to purchase this printer, however: A high duty cycle and rugged construction are its most compelling features.

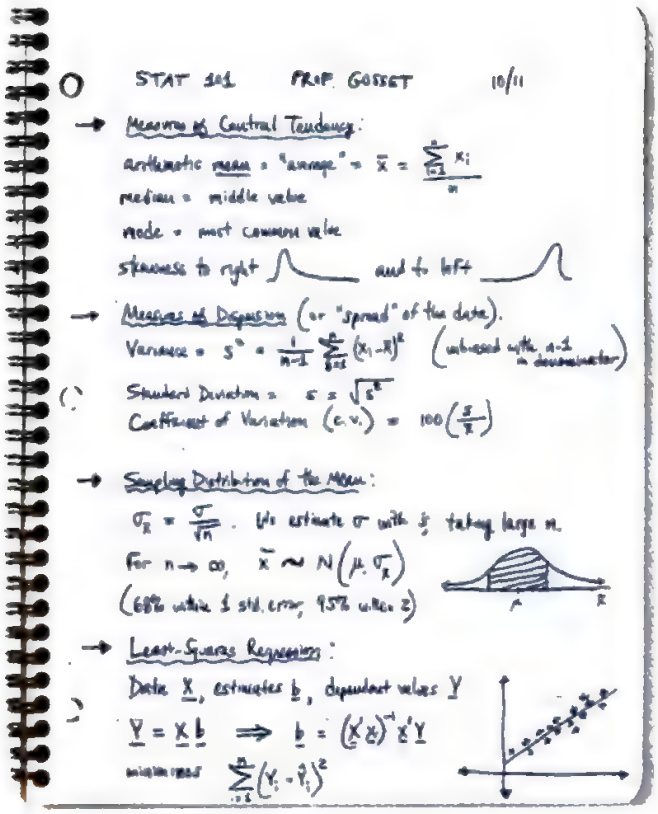
Datasouth XL-300

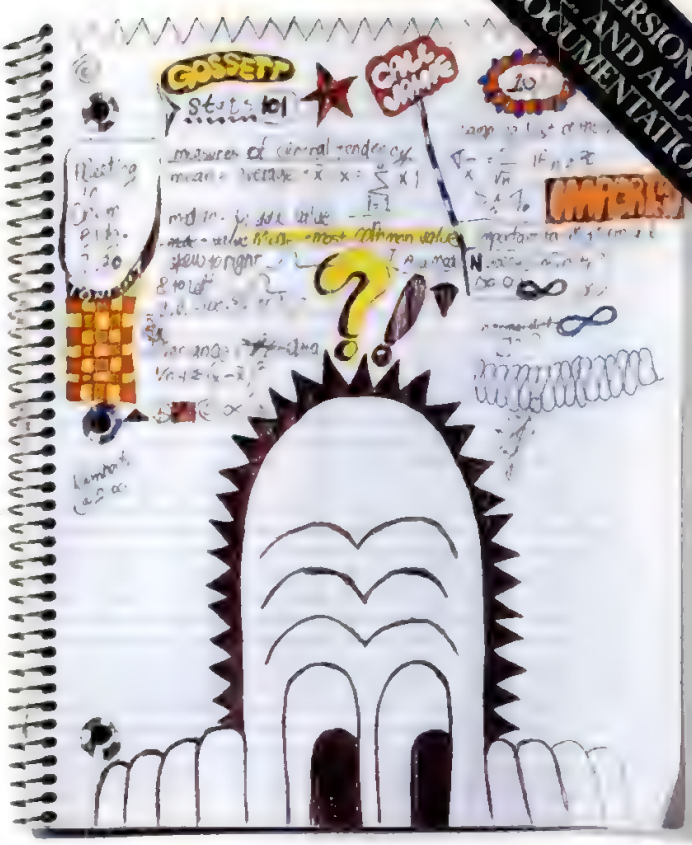
TEST RESULTS



9-pin scores

In Short: The new and improved version of an ultrafast 9 pin, the $1,595 wide-carriage Datasouth XL-300's features and speed are too limited for most PC-oriented needs.





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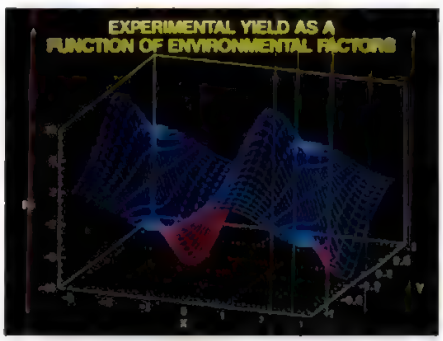

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PC MAGAZINE EDITORS' CHOICE March 14, 1989 STATGRAPHICS

CIRCLE 365 ON READER SERVICE CARD

PC LABS

PERFORMANCE TESTS: 9-PIN DOT MATRIX

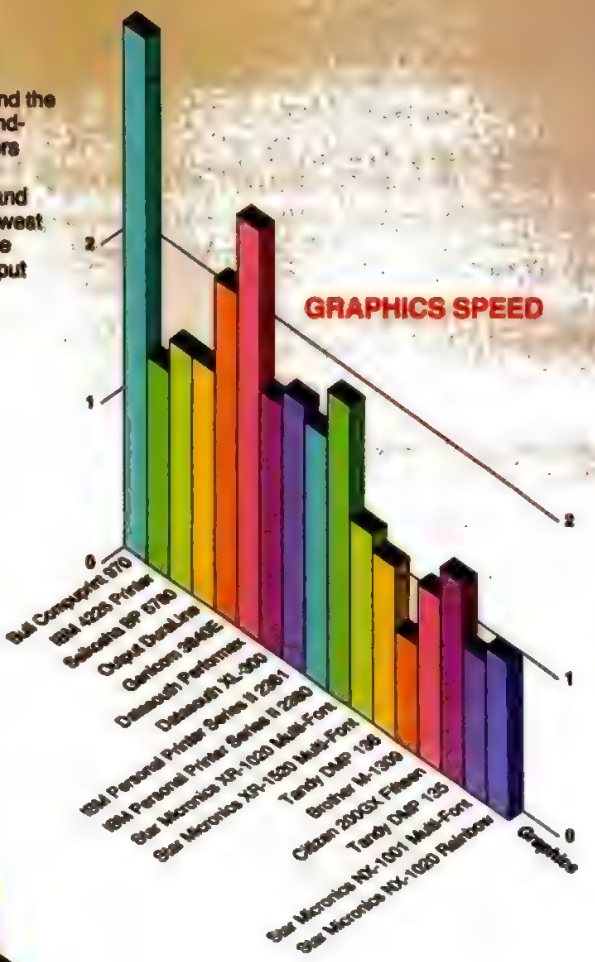
The fastest 9-pin entry this year was the heavy-duty Bull Compuprint 970. It won first place on the text and graphics speed tests. The IBM 4226 Printer was the second-fastest text performer in draft mode, while the Datasouth Performax placed second on graphics.

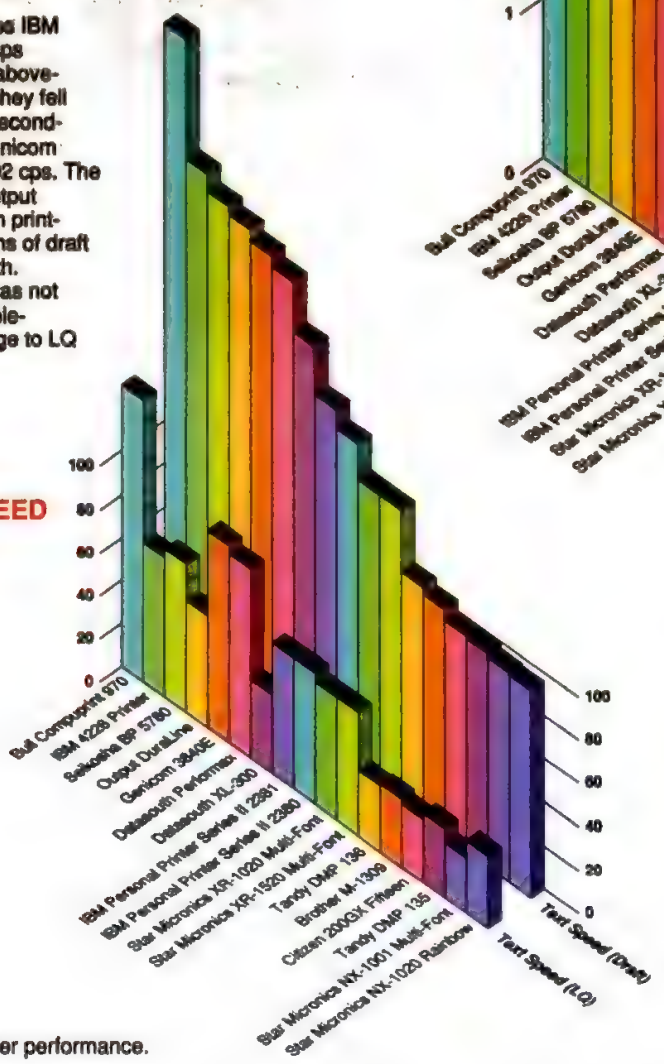
WHAT THE NUMBERS MEAN

Of the 9- and 18-pin dot matrix printers, the fastest performer was the 18-pin heavy-duty Bull Compuprint 970, which swept away the competition at 284 characters per second in draft mode and 131 cps in letter-quality mode. It also received the checkered flag in graphics mode by printing 3.3 graphics pages per minute. The IBM 4226 Printer was the second-fastest draft printer, at 229 cps. It was followed by the 221-cps Seikosha BP 5780.

In LQ mode, the 65-cps IBM 4226 Printer and the 69-cps Seikosha BP 5780 were above-average performers, but they fell relatively far behind the second-fastest LQ printer, the Genicom 3840E, which produced 92 cps. The interestingly designed Output DuraLine (with three 9-pin printheads) was strong in terms of draft printing and came in fourth. However, the DuraLine was not able to translate its multiple-printhead speed advantage to LQ and graphics printing.

The Datasouth Performax and the Genicom 3840E were the second- and third-fastest graphics printers (behind the ever-speedy Bull Compuprint 970), at 2.6 gppm and 2.1 gppm, respectively. The slowest printer in graphics mode was the Brother M-1309, with a throughput speed of 0.7 gppm.





The Text Speed test measures the time it takes to send and print one copy of a two-page business letter with 1-inch margins in 10-cpi type. The test is performed twice, once in draft mode and once in LQ mode. Results are reported in characters per second.

The **Graphics Speed** test measures the time it takes to send and print two copies of a graphics image created by using *PageMaker* and *Microsoft Windows*. Results are reported in graphics pages per minute.

Taller bars represent better performance.

PERFORMANCE TESTS: 24-PIN DOT MATRIX

PC LABS

The fastest 24-pin text printer in draft and LQ modes was the NEC Pinwriter P9300. But despite this favorable performance, the P9300 came in near the bottom on graphics printing; the Epson LQ-870 and LQ-1170 were the fastest by a large margin.

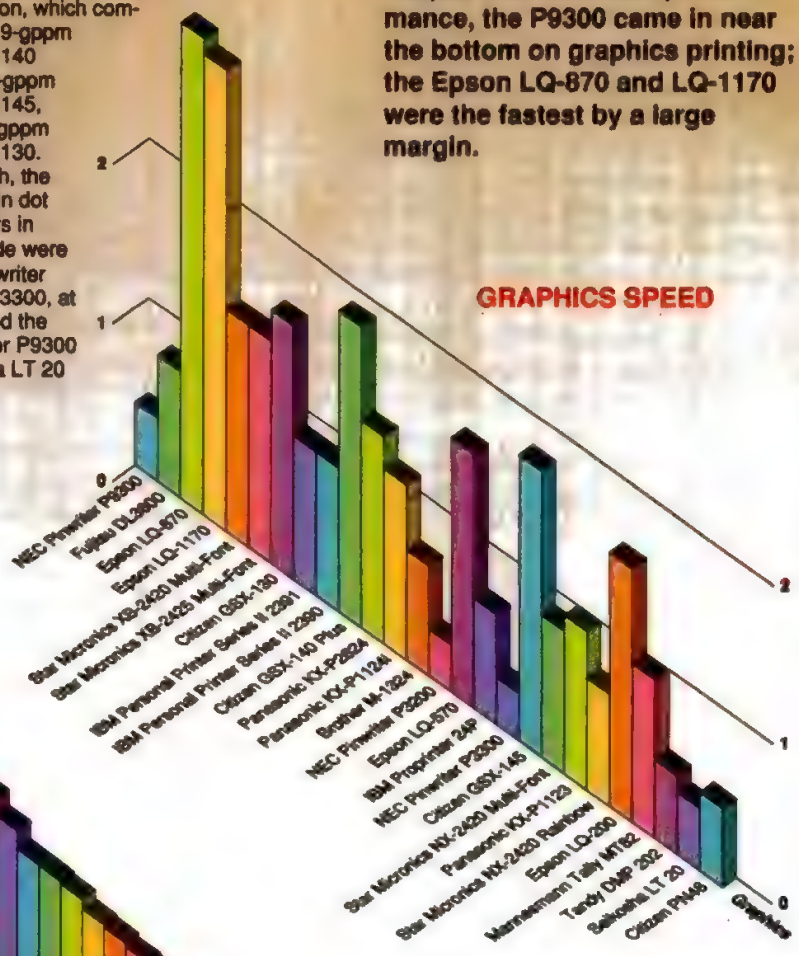
WHAT THE NUMBERS MEAN

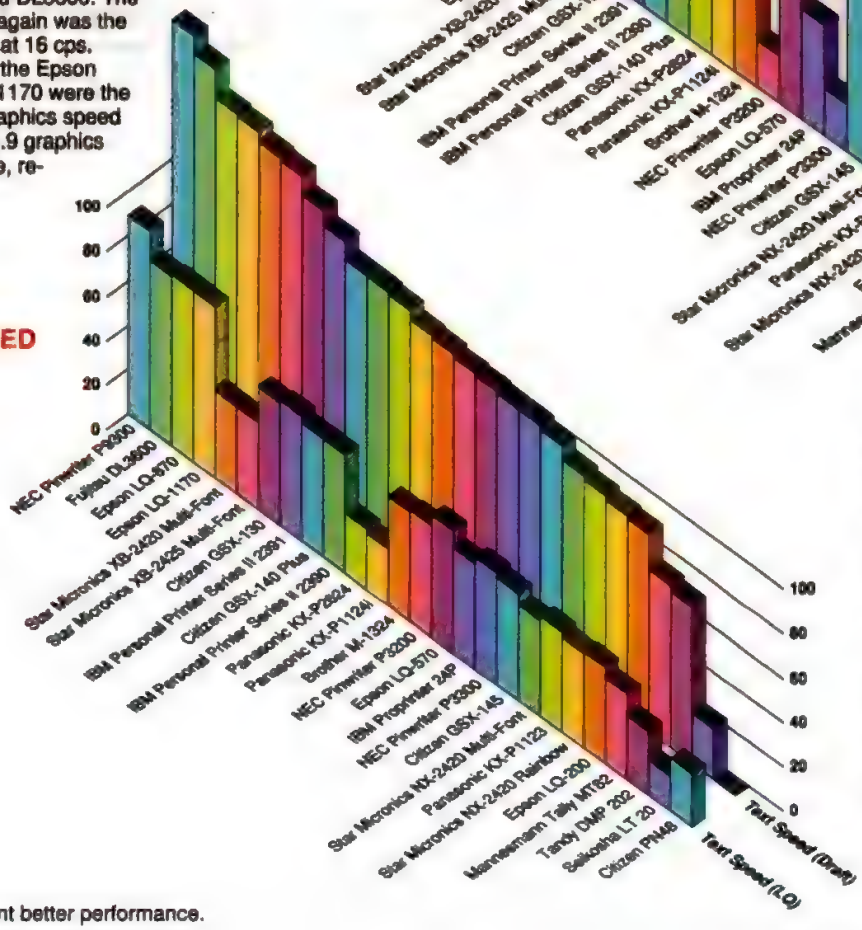
The fastest 24-pin dot matrix printer on our draft-speed printing test was the NEC Pinwriter P9300, at 162 characters per second, with the Fujitsu DL3600 running a fairly close second, at 154 cps. The 23-cps Seikosha LT 20 was the slowest printer in draft mode—only 7 cps faster than its letter-quality mode and 48 cps slower than the Tandy DMP 202, the second-slowest 24-pin printer. However, the Seikosha trades speed for a laptop design. Note that *PC Magazine*'s Editors' Choice among laptop printers, the Citizen PN48, produces only LQ output—an inherent attribute of its thermal-fusion printing process.

In LQ mode, the NEC Pinwriter P9300 again was the fastest printer—12 cps faster than the second-fastest Epson LQ-1170 and LQ-870 (wide- and narrow-carriage versions of the same print mechanism) and 13 cps faster than the third-place Fujitsu DL3600. The Seikosha LT 20 again was the slowest, printing at 16 cps.

Interestingly, the Epson LQ-870 and LQ-1170 were the fastest on our graphics speed test, at 3.0 and 2.9 graphics pages per minute, respectively.

The two Epsons were as much as twice as fast as the rest of the competition, which comprised the 1.9-gppm Citizen GSX-140 Plus, the 1.8-gppm Citizen GSX-145, and the 1.6 -gppm Citizen GSX-130. Oddly enough, the slowest 24-pin dot matrix printers in graphics mode were the NEC Pinwriter P3200 and P3300, at 0.3 gppm, and the NEC Pinwriter P9300 and Seikosha LT 20 at 0.4 gppm.





The Text Speed test measures the time it takes to send and print one copy of a two-page business letter with 1-inch margins in 10-cpi type. The test is performed twice, once in draft mode and once in LQ mode. Results are reported in characters per second.

The **Graphics Speed** test measures the time it takes to send and print two copies of a graphics image created by using *PageMaker* and *Microsoft Windows*. Results are reported in graphics pages per minute.

Taller bars represent better performance.

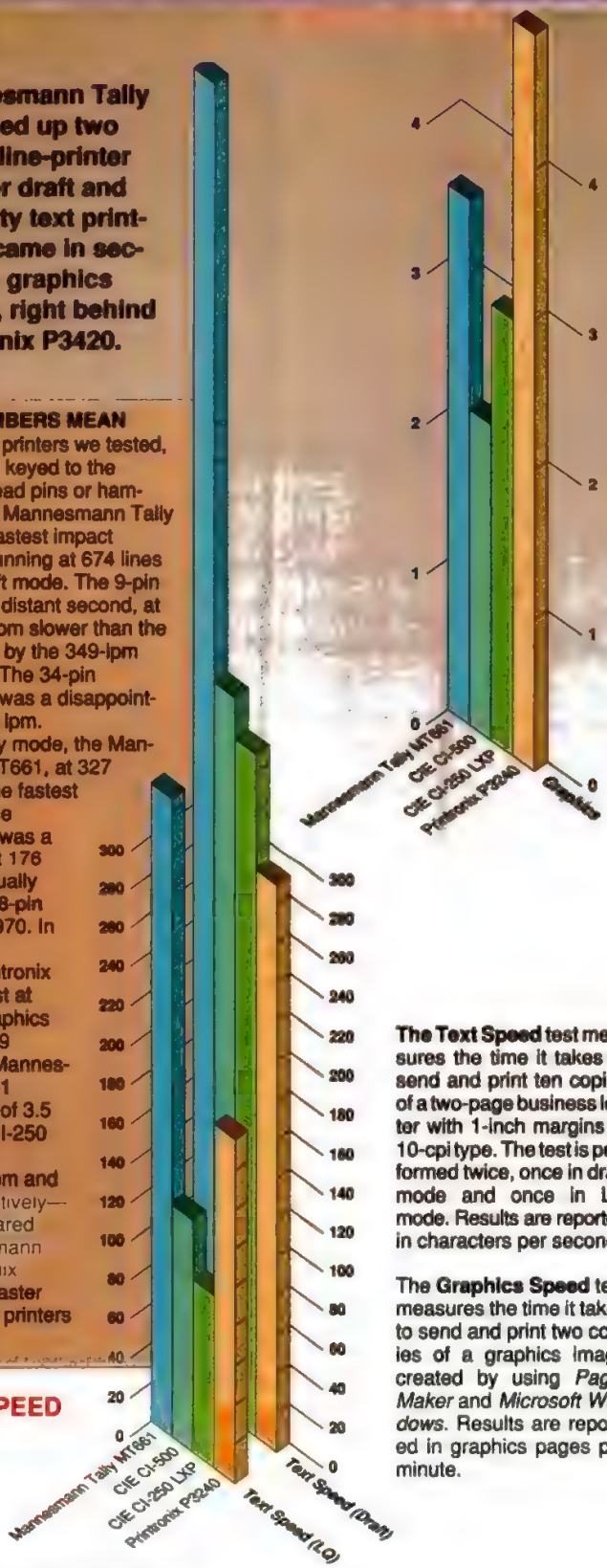
PERFORMANCE TESTS: LINE PRINTERS

The Mannesmann Tally MT661 tallied up two first-place line-printer trophies for draft and letter-quality text printing, but it came in second on the graphics speed test, right behind the Printronix P3420.

WHAT **THE NUMBERS MEAN**

With the four line printers we tested, performance was keyed to the number of printhead pins or hammers. The 66-pin Mannesmann Tally MT661 was the fastest impact printer we saw, running at 674 lines per minute in draft mode. The 9-pin CIE CI-500 ran a distant second, at 370 lpm (or 304 lpm slower than the MT661), followed by the 349-lpm CIE CI-250 LXP. The 34-pin Printronix P3420 was a disappointment, at only 290 lpm.

In letter-quality mode, the Mannesmann Tally MT661, at 327 lpm, was again the fastest impact printer. The Printronix P3240 was a distant second, at 176 lpm, and was actually slower than the 18-pin Bull Compuprint 970. In graphics mode, however, the Printronix P3420 was fastest at producing our graphics image, printing 4.9 gppm, while the Mannesmann Tally MT661 turned in a score of 3.5 gppm. The CIE CI-250 LXP and CI-500 produced 2.9 gppm and 2.1 gppm, respectively—slow when compared with the Mannesmann Tally and Printronix printers, but still faster than most impact printers in this roundup



The Text Speed test measures the time it takes to send and print ten copies of a two-page business letter with 1-inch margins in 10-cpi type. The test is performed twice, once in draft mode and once in LQ mode. Results are reported in characters per second.

The **Graphics Speed** test measures the time it takes to send and print two copies of a graphics image created by using *PageMaker* and *Microsoft Windows*. Results are reported in graphics pages per minute.

Taller bars represent better performance.

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PC MAGAZINE EDITORS' CHOICE June 25, 1991 ATI 8514-ULTRA

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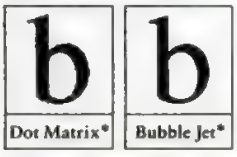
Please dispose of your old dot matrix printer properly.

Face it, dot matrix printing just doesn't fly anymore. Why, you ask? Because now there are the new Bubble Jet™ personal printers from Canon. An innovative way to give your letters and charts laser quality crispness at a dot matrix price. Blacks are blacker and graphics look more defined.



All this, from a printer that's both small and quiet enough to use practically anywhere. When you combine this with the Bubble Jet personal printer's compatibility with popular software and Canon's reputation for reliability, your old ideas about printing go right out the window. If it's high time your old printer hit the road, please call 1-800-848-4123.

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Output enlarged with Adobe Type Manager.™ Dot matrix output printed on a leading 24-pin printer. BJ is a registered trademark and Bubble-Jet is a trademark of Canon Inc. Adobe Type Manager and ATM are trademarks of Adobe Systems Inc. in the U.S.A. © 1991 Canon U.S.A., Inc. One Canon Plaza, Lake Success, N.Y. 11042

CIRCLE 187 ON READER SERVICE CARD

The Performax is the only one of these Datasouth printers to appeal unequivocally to the PC marketplace. Its high speed and paper-handling performance are hard to beat, especially in a high-duty-cycle printer.

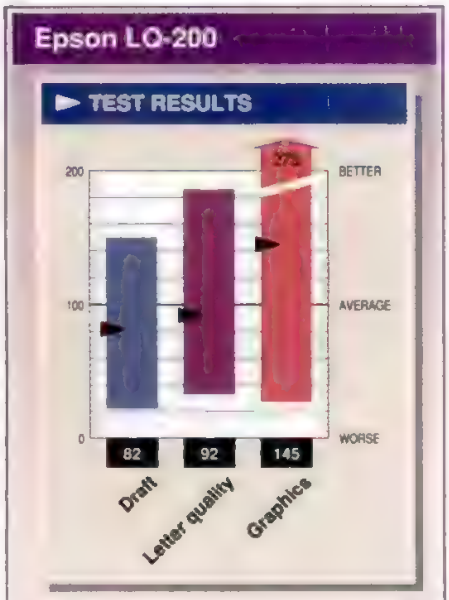
FACT FILE

Datasouth Computer Corp., P.O. Box 240947, Charlotte, NC 28224; 800-476-2120, 704-523-8500.

Datasouth Performax
List Price: $2,995; with internal cut-sheet feeder and tractor, $3,295; bar code/industrial graphics, $300.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 9 x 26 x 18 inches.
Weight: 47 lbs.
Emulations: DEC LA-120, Epson FX, IBM Graphics Printer, IBM Proprinter.

Datasouth XL-300
List Price: $1,595; bar code/OCR, $150.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 8 x 25 x 16 inches.
Weight: 35 lbs.
Emulations: Datasouth DS-180, DEC LA-120, Epson FX.

CIRCLE 400 ON READER SERVICE CARD



24-pin scores

In Short: An entry-level printer, the $399 24-pin narrow-carriage Epson LQ-200's respectable speed and good type make it worth the price.

EPSON AMERICA INC.

Epson LQ-200
Epson LQ-570
Epson LQ-870
Epson LQ-1170

by Bill O'Brien

Hold on to your continuous forms! Epson has just lowered the floor and raised the ceiling on matrix printing. In a market segment that many have claimed is already dead, Epson has come up with a potentially life-giving concept: internal scalable fonts.

This year, the company has four new printers: the $399 24-pin narrow-carriage LQ-200, the $499 24-pin narrow-carriage LQ-570, the $749 24-pin narrow-carriage LQ-870, and the $1,049 24-pin LQ-1170 (a wide-carriage version of the LQ-870). Each printer adds to the features of the one before it; and the LQ-870 and LQ-1170 replace the two-time Editors' Choice–winning LQ-850 and LQ-1050, while the LQ-570 replaces the older LQ-510. Epson has enhanced its new brood with a variety of document-handling options, more bitmapped fonts than ever, and even scalable-font technology.

FONT-TECHNOLOGY BUGS

The big news for Epson in 1991 is scalable fonts, but don't look for major headlines immediately. The LQ-570, LQ-870, and LQ-1170 all have scalable fonts, accessed through an enhanced version of Epson's ESC/P dot matrix printer command language called ESC/P2. Although this is an innovation for a dot matrix engine, there are only two fonts in the Epson machines, sans serif and Times Roman.

Also, font sizes for the pair may disappoint some. They can be scaled only between 8- and 32-point sizes. While 6 points might have been a better lower boundary for the desktop-publishing crowd, even with the printers' resolution of 360 by 360 dots per inch the size of each dot becomes an issue, and characters are subject to aliasing (the jaggies).

At the top end of the scale, at least 36 points (half an inch) might have been a better choice, but as the size of a scalable font increases, so does the amount of memory needed for its scaling algorithm, as well as the amount of time needed for the algorithm to scale the font. Thus, larger sizes become impractical for current dot matrix technology and affordability.

Last, though the ESC/P2 language is compatible with *Microsoft Windows* 3.0, you will not be able to access *Windows'* scalable fonts. Since the documentation fails to mention this, new users may spend a few frustrating hours battling their *Windows* Print Manager. Epson claims this is due to limitations set by Microsoft that prohibit the use of internal fonts by any printer. Supported DOS applications can make use of the scalable fonts, and drivers are included for *DrawPerfect*, Version

1.1; *LetterPerfect*, Version 1.0; *Microsoft Word*, Version 5.5; *PlanPerfect*, Version 5.1; *WordPerfect*, Version 5.1; and *WordStar*, Version 6.0. The scaled output we acquired under *Word* 5.5 was satisfactory, but print quality still falls short of *Adobe Type Manager* under *Windows* (especially in the larger point sizes). Outside these applications, you will have to be satisfied by backward compatibility with the old LQ line until other drivers for the scalable functions arrive.

COMMON GROUND

Each of the new models comes with a Centronics parallel interface and has an 8K internal buffer. Except for the LQ-200, all of the models also have an optional 32K buffered parallel or serial interface ($152). Epson has done an excellent job on the optional interfaces, designing them as plug-in modules that can be added or removed without disassembling the printer.

All of the models also share a top-mounted control-and-status panel. Using membrane keys and labeled LEDs, Epson has devised a competent method of selecting fonts and features without resorting to the expense of an LCD. While it is necessary to deal with a DIP switch (conveniently located on the printer's front panel) to access some of the more esoteric functions, you won't need the manual to use these printers on a daily basis.

For the day when you do need it, it's a comfort to know that there has never been a better Epson printer manual. All four manuals are cleanly written, extremely precise, and profusely illustrated.

THE LQ-200

If it weren't for the $399 list price, it would be difficult to believe that the LQ-200 is an entry-level printer. Epson rates the printer at 160 cps in draft mode, and the tested printer speed managed 89 characters per second—a better than respectable rating for the price.

The LQ-200's new draft mode is much better than some of Epson's older versions, leaving only a slightly lighter print impression than one of the six LQ fonts (it can also do OCR-B). In letter-quality mode (there is a mylar ribbon option), the LQ-200 uses a 29- by 23-dot matrix, and Epson claims 53 cps at 10 characters per inch. The LQ-200 turned in a respectable 44 cps.

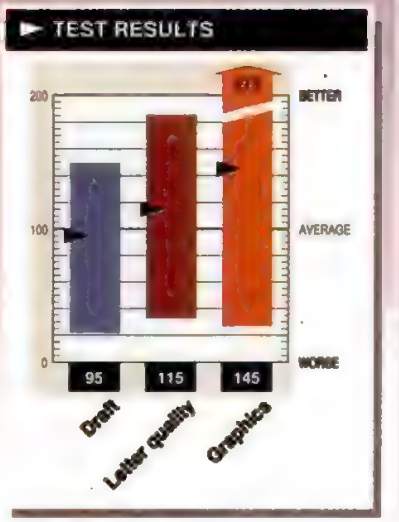
Paper-handling options are arranged around two basic methods: friction or tractor feed. Friction can be through either the cut-sheet feeder or the optional $149 100-sheet cut-sheet feeder. The included pull tractor gives you the option of routing paper through the top, bottom, or rear.

THE LQ-570

One rung up the ladder is the first of Epson's ESC/P2 printers, the $499 24-pin narrow-carriage LQ-570. The extra $100 over the cost of the LQ-200 buys you a tested speed of 103 cps in draft mode (though there is a slightly faster super-draft mode) and 55 cps in LQ mode. The printer includes an OCR-B font and two versions of Orator (one with small caps and one with lowercase letters). Of course, it also includes the scalable versions of sans serif and Times Roman.

Paper-handling options are increased to include a push/pull tractor (a second pull tractor is optional for $64) with bottom, rear, and front paper-feed abilities as well as single-sheet friction feed through the top or front. There are also two optional cut-sheet feeders in 50- or 150-sheet sizes (for $73 and $192, respectively, with the latter feeder also envelope-capable). And the LQ-570 offers paper automation with auto-feed and paper-parking facilities. About the only drawback is that you must manually select the various feed options.

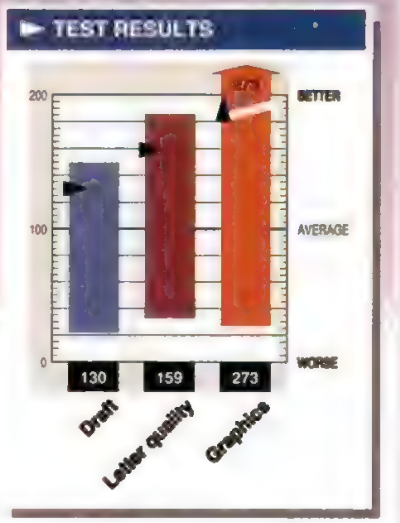
Epson LQ-570



24-pin scores

In Short: The lowest-priced of Epson's new ESC/P2-capable machines, the $499 24-pin narrow-carriage Epson LQ-570 also has slightly improved paper handling.

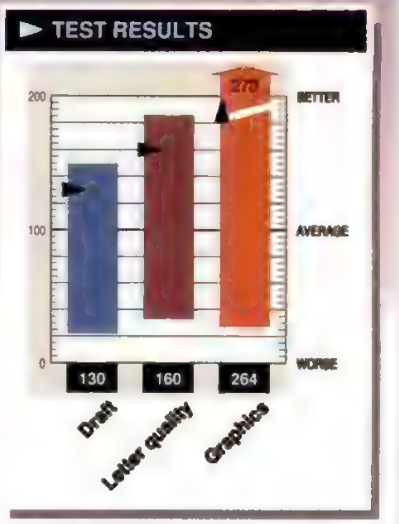
Epson LQ-870



24-pin scores

In Short: Replacing the venerable LQ-850, the $749 24-pin narrow-carriage Epson LQ-870 contains ESC/P2 scalable-font technology, improved paper handling, the same competitive performance, and no increase in cost.

Epson LQ-1170



24-pin scores

In Short: The $1,049 24-pin wide-carriage Epson LQ-1170 replaces the LQ-1050 and builds upon its ancestor's traits with improved paper handling and ESC/P2 scalable-font technology.

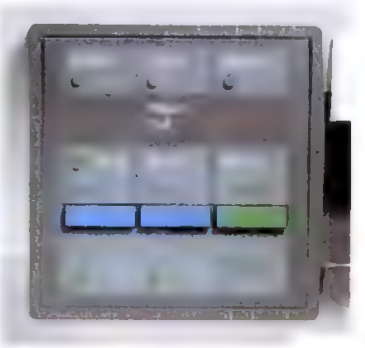
EASY TO USE: Control Panels Improve

by Oliver Rist

Today's highly competitive dot matrix vendors are not just concentrating on raw print speed, they're expending energy on designing ergonomic controls, too. The easiest-to-use control panels we saw were on the IBM Corp./Lexmark machines. Both the IBM Proprinter 24P and the IBM Personal Printer Series II printers (like the Series II 2380 pictured) have such easy front panels that you should be able to operate them without a manual the very first time. Starting with six LED indicator lights and only three push buttons (which had to be pressed in varying combinations to achieve different functions), as exemplified by the IBM Proprinter X24 pictured here, IBM has gone to the simple one-button-to-one-function format seen on the 2380. The only minor annoyance is that the power switch is still located on the right in the rear.

Epson America's new LQ series runs a close second and is similar to the IBM machines. While a difficult three- membrane key structure is still in use on this year's low-end Epson LQ-200, on its higher-end LQ printers Epson used a format—seen here on the Epson LQ-870—which includes features such as a separate font-select button, easy-to-understand paper loading and parking keys, and front-mounted power and DIP switches. The Epson's new panel, however, falls slightly short of the IBM panel mainly due to the lack of an on-line indicator or control and to a nonintuitive Alt key that still requires you to spend some time perusing the manual.

Panasonic Communications & Systems Co. claims to have recently improved on its old matrix-menu layout scheme (typified for many users by the now-discontinued Panasonic KX-P1124) by removing the matrix layout diagram and adding an LCD screen on its higher-end products (the Panasonic KX-P1124i and Panasonic KX-P2624). But the new LCD control proved unremarkable and merely typical of many other vendors' implementations; it will still warrant some quality time with your manual.



IBM Proprinter X24: the old way.

Epson LQ-200: only three membranes.

IBM Personal Printer Series II 2380: new and intuitive.

Epson LQ-870: good, but no on-line indicator.

THE LQ-870 AND LQ-1170

The $749 24-pin narrow-carriage LQ-870 and $1,049 24-pin wide-carriage LQ-1170 are Epson's business-class printers, and they are rated at 300 cps at 10 cpi in draft mode. PC Magazine Labs' printer speed test scores uphold Epson's claim; the printers scored about 141 cps in draft mode and roughly 77 cps in LQ mode.

Paper-handling options for the LQ-870 and the LQ-1170 are the same as for the LQ-570. There is, however, one important exception. You can simultaneously mount both of the cut-sheet feeders, and when these are combined with the possibility of using the two tractors (there is one at the rear and one at the front), you are given a total of four paper paths available simultaneously. Here, too, paper handling is restricted to manual control by a lever that is located at the top of the printer; software control would have been preferable, especially in a business-class printer.

> *Whether Epson's scalable-font technology breathes new life into the dot matrix market remains to be seen.*

THE BREATH OF LIFE

Whether Epson's scalable-font technology will breathe new life into the declining dot matrix market remains to be seen. With only two fonts supported and a shaky initial implementation, Epson's "revolution" may be worth only a polite nod this time around. On the other hand, the printers' scalable ability comes at no extra cost over the old LQ-850 and LQ-1050, and these new printers are excellent dot matrix machines even without it. Even though Epson hasn't announced any cartridge upgrades to ESC/P2, the printers each have a cartridge slot. If Epson smoothes out its implementation and expands the font library, the future could be bright.

printers DOT MATRIX

FACT FILE

Epson America Inc., 20770 Madrona Ave., Torrance, CA 90503; 800-922-8911, 213-782-0770.

Epson LQ-200
List Price: $399; 100-sheet cut-sheet feeder, $149.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 6 x 15 x 13 inches.
Weight: 15 lbs.
Emulations: Epson LQ.

EDITORS' CHOICE

Epson LQ-570
List Price: $499; pull tractor, $64; 50-sheet cut-sheet feeder, $73; 150-sheet cut-sheet and envelope feeder, $192; serial interface, $88; parallel or serial interface with 32K buffer, $152.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 6 x 17 x 15 inches.
Weight: 15 lbs.
Emulations: Epson ESC/P2, fully backward-compatible with Epson ESC/P.

EDITORS' CHOICE

Epson LQ-870
List Price: $749; pull tractor, $69; 50-sheet cut-sheet feeder, $73, 150-sheet cut-sheet and envelope feeder, $192; serial interface, $88; parallel or serial interface with 32K buffer, $152.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 7 x 18 x 15 inches.
Weight: 20 lbs.
Emulations: Epson ESC/P2, fully backward-compatible with Epson ESC/P.

EDITORS' CHOICE

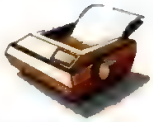
Epson LQ-1170
List Price: $1,049; pull tractor, $86; 50-sheet cut-sheet feeder, $102, 150-sheet cut-sheet and envelope feeder, $240; serial interface, $88; parallel or serial interface with 32K buffer, $152.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 7 x 25 x 15 inches.
Weight: 27 lbs.
Emulations: Epson ESC/P2, fully backward-compatible with Epson ESC/P.

CIRCLE 401 ON READER SERVICE CARD

FUJITSU AMERICA INC.

Fujitsu DL3600

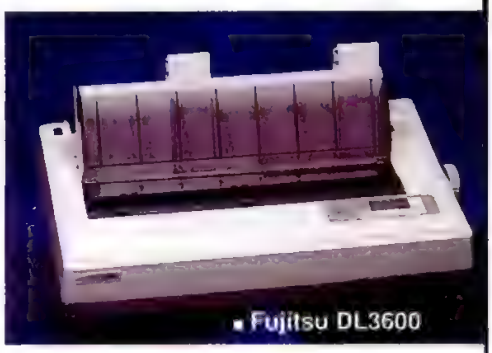
by Wendy Dugas Pérez



In last year's printer blockbuster (November 13, 1990), we praised Fujitsu America's DL4600 for its fast speed and quality performance. Its high price, however, was considered a real drawback. This year's 24-pin wide-carriage DL3600 was able to top its higher-end counterpart in the speed department and still produce quality output while offering a $949 list price—$250 less than the list price of the DL4600 today.

Fujitsu sees the DL3600 as sitting right in the middle of the company's dot matrix line. Selling through a two-tier distribution channel, with its primary channel being resellers, Fujitsu markets the DL3600 to front offices.

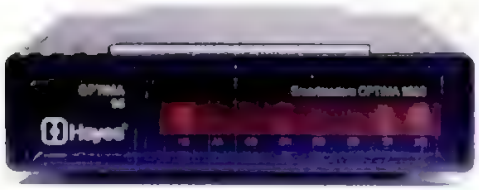
The DL3600 measures 9 by 23 by 14 inches and weighs in at a fairly hefty 27 pounds. It sells for a street price of approximately $600. Options available include a color option for $100, font cards ranging from $50 to $145, and $129 emulation cards.



▪ Fujitsu DL3600

Other options are a $295 100-sheet single-bin cut-sheet feeder, a $285 200-sheet dual-bin attachment, and a $117 serial interface (in case you can't use the standard parallel interface). Replacement supplies include black ribbons for $13, color ribbons for $27.60, and a printhead for $225 (although it is not likely that you will need one any time soon, as the DL3600's printhead is rated at 200 million strokes per wire).

The DL3600 supports emulations for the Epson LQ, Fujitsu DPL24C Plus, and IBM Proprinter. DEC-series emulations, along with Fujitsu DPL24D (Diablo 630 API), are also available with the optional emulation cards.



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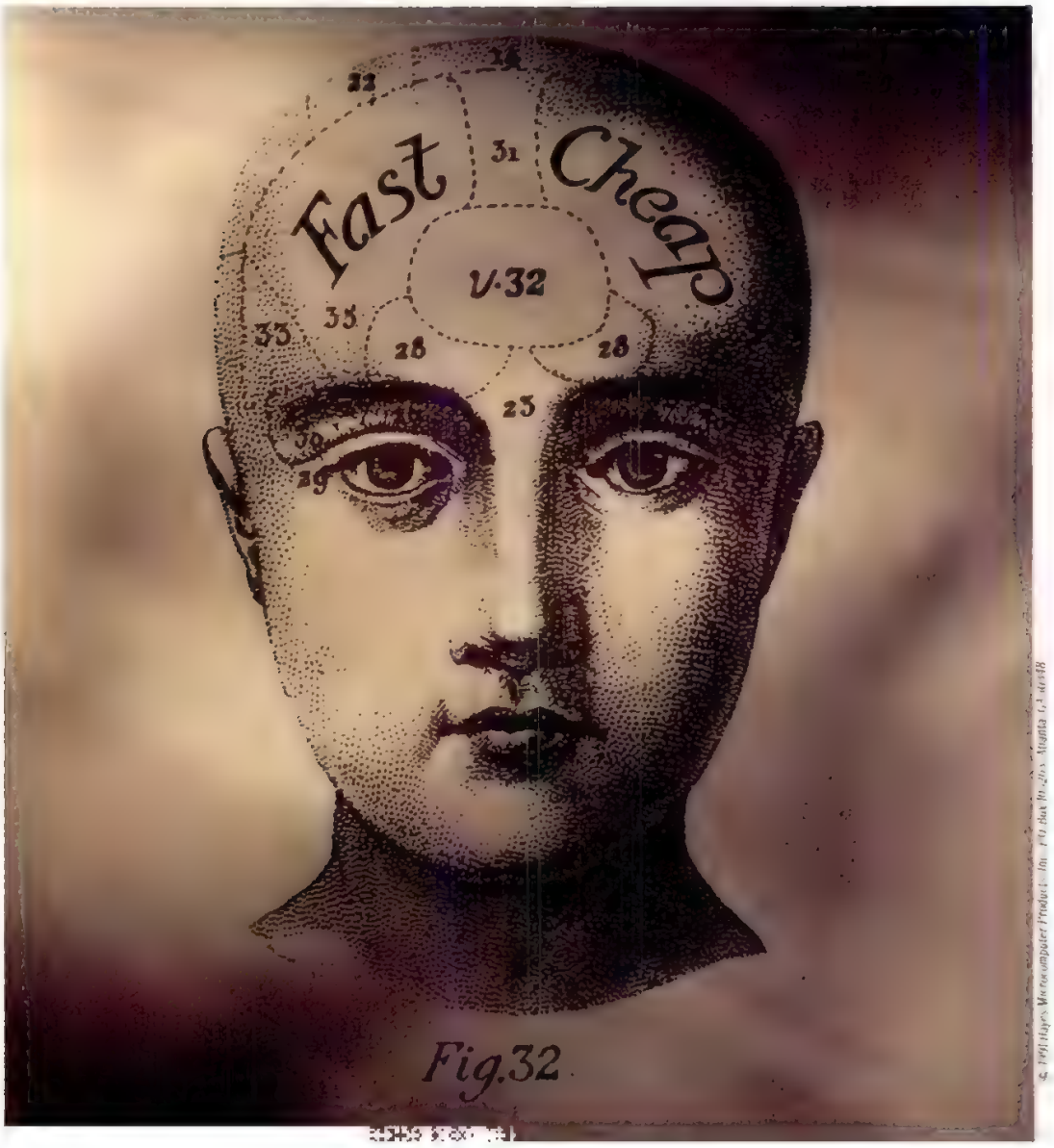


FACT FILE

Genicom Corp., One Genicom Dr., Waynesboro, VA 22980; 800-443-6426, 703-949-1000.

EDITORS' CHOICE

Genicom 3840E

List Price: $2,595; font cards, $100 each; paper shear, $299; paper shear with catch tray, $399; additional 64K RAM buffer, $100; pedestal, $120.

Standard Warranty: One year on parts and labor; Genicom on-site service, $29 a month.

Dimensions (HWD): 12 x 27 x 14 inches.

Weight: 52 lbs.

Emulations: ANSI 3.64, DEC LA-210, Epson FX, IBM Graphics Printer, IBM Proprinter.

CIRCLE 403 ON READER SERVICE CARD

IBM CORP./LEXMARK

IBM 4226 Printer

IBM Personal Printer Series II 2380

IBM Personal Printer Series II 2381

IBM Personal Printer Series II 2390

IBM Personal Printer Series II 2391

IBM Proprinter 24P

by John R. Quain

This year's IBM 9-pin and 24-pin printers deliver better paper handling and ergonomics than past Proprinters. Ranging in price from $499 to $2,295 in narrow- and wide-carriage editions, these printers are more reasonably priced than previous IBM impact offerings and are best suited for small-business users who need trouble-free multipart-forms printing.

Lexmark International—the company responsible for IBM's previous personal printers—became an independent company last March (though IBM retains a 10 percent stake in the manufacturer and is its biggest customer). Under a five-year license for Lexmark to manufacture Big Blue's printers, five of the six printers in this review were introduced after the company's independence and mark a new approach to personal impact printers under the IBM logo.

THE 4226 PRINTER

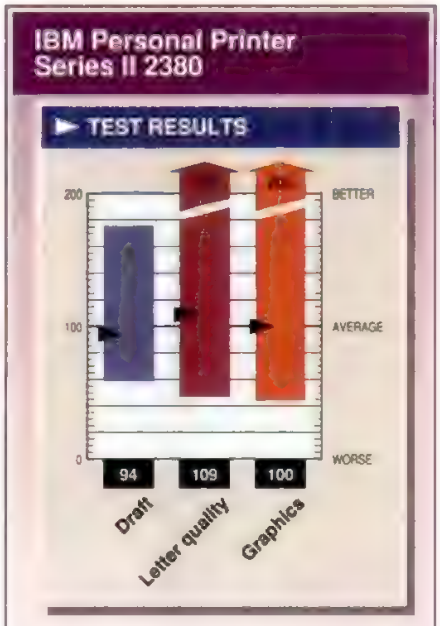
First is a new speed demon, the 9-pin $2,295 IBM 4226 Printer. On PC Magazine Labs' text speed test, it delivered a top velocity of 229 characters per second in its native draft mode at 10 characters per inch and yielded a determined 65 cps in letter-quality mode. Although it turned out an unremarkable speed of 1.3 graphics pages per minute on the suite of graphics tests, the printer revealed an ability to produce better shading than other IBM/Lexmark printers here.

With extensive sound damping and a 32-character LCD control panel, the 4226 is quiet and sleek. There isn't even an external platen knob; once you clamp down the push tractors, paper loads automatically with the push of a button. A clear rectangular window on the printer top allows you to see paper and printhead positions.

Finesse, however, is not its forte: The 4226 offers only four fonts (Courier, draft, fast draft, and Gothic) and three print modes (draft, a slightly speedier fast draft, and near-letter quality). It has two emulations, Epson DFX-5000 and IBM Proprinter, and is rated for a maximum graphics resolution of 240 by 144 dots per inch.

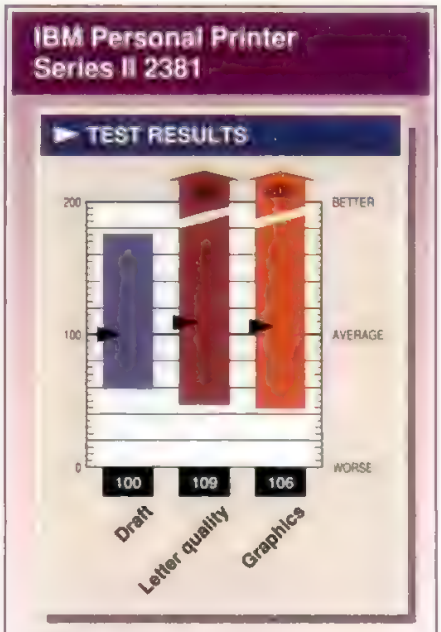
Intended as the PC equivalent of a minicomputer's line printer, the belt-driven 4226 accepts only continuous-form paper using a bottom front-fed S path in a compact wide-carriage 25- by 11-inch footprint. It can manage six-part forms up to a maximum thickness of 0.52 millimeters. The 4226 also comes equipped with two switches in back that allow you to set the 36-pin Centronics-style parallel port as a serial port—either RS-232C at 19.2 kilobits per second or RS-422 at 38.4 Kbps.

Outfitted with 22K of base-priced memory (no memory upgrades are available), the 4226 is a little trickier to set up than the other new IBM/Lexmark printers. Whereas the 2300-series models print out step-by-step instructions, the 4226 relies on its LCD to communicate with the user. Unfortunately, the LCD readouts are far from intuitive, requiring you use the user manual to decipher the various abbreviations. Beyond those two minor annoyances, however, users should appreciate the 4226's automatic paper-loading



9-pin scores

In Short: Expensive for a 9-pin model, the $499 narrow-carriage IBM Personal Printer Series II 2380 is nevertheless a solid printer with good paper handling (especially for heavy multipart forms), though its type quality is limited.



18-pin scores

In Short: Another expensive printer, the $699 9-pin IBM Personal Printer Series II 2381 offers the same features as the 2380 but has a wide carriage.

feature, its automatic top-of-form control, and its printing alacrity.

If your sole desire is rapid printing and multipart-forms handling, but you don't have the patience to deal with a line printer, the IBM 4226 is worth considering.

these four IBM models concentrate on smoother paper handling and easy operation.

FOUR NEW PERSONAL PRINTERS

The four IBM Personal Printer Series II models—the $499 9-pin narrow-carriage 2380, the $699 9-pin wide-carriage 2381, the $499 24-pin narrow-carriage 2390, and the $699 24-pin wide-carriage 2391—were all introduced in July and represent new designs for IBM dot matrix printers. These four models concentrate on smoother paper handling and easy operation. All four offer IBM Proprinter and Epson emulations.

Using a belt-driven print mechanism, these models sport a new vertical chassis design reminiscent of a toaster oven. All use front paper loading for continuous forms, providing an L-shaped paper path that all but eliminates jams. After each print job, the printers automatically set fanfold paper into a tear-off position and then roll it back to the top of the form at the start of the next job. The push-tractor assembly is designed to allow removal and repositioning for pull operation.

Optional open-tray 150-sheet feeders fit easily into the front of all the printers. And even with the bin feeders installed, you can manually insert envelopes or print on continuous forms simply by flipping the bail lever and pushing the load button. The feeders add about 5 inches to the printers' depths and cost $199 for the narrow-carriage and $239 for the wide-carriage version.

Color coding on the control panels means you can operate the eight-button front panels on the Series II printers without studying the manual. Supplementing this ease of use, the Series II models print out their own setup instructions. If you take the printer off-line and press Alt and Setup, the printer will print out the menu options and tell you which button to press next. It eats a bit of paper (the average setup change during PC Labs' tests took about 1.5 pages), but the user is more than compensated in terms of time savings and ease of operation.

Each series II model comes with a Centronics parallel port, an RCA-style jack on the back to accommodate a serial-port adapter option (RS-232C or RS-422 for $125), and a snap-off back panel to allow entry for ROM and memory options.

THE 9-PINS

The new 9-pin pair of the Series II line consists of the narrow-carriage $499 2380 and its wide-carriage version, the $699 2381. Both have a maximum rated graphics resolution of 240 by 144 dots per inch, can handle six-part forms (up to 0.51 millimeters thick), and come with 11K of base-priced memory. An optional user-installable memory upgrade of 32K costs $55. The resident font options are Courier, draft, fast draft, and Gothic (the two drafts are sans serif faces). The 2380 measures 10 by 19 by 15 inches, and the 2381 is only about 6 inches wider. Both use small clamshell ribbons.

When running in IBM mode on PC Labs' printer tests, the 2380's graphics performance varied. Image quality degenerated with increased use, and horizontal banding became apparent whenever it printed more than two consecutive images. Moreover, after printing six samples of the test image, the printhead became noticeably slower. Engineers at IBM/Lexmark explained that the reduction in speed is the result of an automatic sensing mechanism that slows down the printhead to prevent heat damage. Those users who do a lot of graphics printing should note that these models were not intended for intensive graphics use. The halftone images the 2380 produced were very dark, as one would expect on a 9-pin printer, but its speed was acceptable, at roughly 1.7 gppm.

Both printers turned in speedy scores on the text speed test. Using the IBM emulation in draft mode at 10 cpi, the 2380's top speed was 153 cps, while the 2381 came in at 162 cps. LQ print was clean and dark. Clocked speeds in this mode reached about 61 cps for both machines.

THE 24-PINS

With the same look, feel, and prices as the 9-pin Series II models, the $499 narrow-carriage 2390 and the $699 wide-carriage 2391 seem to be the buyer's obvious choice. However, their features are different from those of their cousins, and though print quality is improved, there is a slight speed penalty.

Identical aside from their carriage sizes, the 2390 and 2391 offer more resident fonts (adding Orator, Prestige, Presentor, and script to the standard four on the 2380 and 2381 models) and a higher-rated maximum resolution of 360 by 360 dpi. This pair is also a bit larger: The 2390 is 10 by 19 by 15 inches, and the 2391 with its extended carriage is about 6 inches wider.

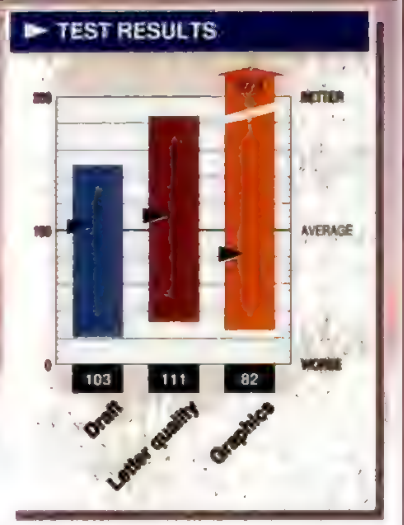
With the same prices as the 9-pin Series II models, the 2390 and 2391 seem to be the obvious choice.

While the 9-pin pair is capable of handling heavy forms, these cannot. The 2390 and 2391 are rated to handle four-part forms (the 2380 and 2381 can handle six-part forms) and deal with paper up to a maximum thickness of up to 0.36 millimeters (while the two 9-pin printers extend themselves to a 0.51-mm. limit).

The 24-pin pair come with 32K of memory standard—21K more than the base-priced memory offered with the 9-pin models. But the memory options for the 2390 and 2391 will not increase the printers' actual buffer size. Both the 32K volatile chip ($55) and 32K nonvolatile chip ($79) are for downloading fonts only. A $35 floppy disk of available fonts includes enhanced LQ faces that are impressively sharp, and OCR-A and OCR-B fonts for creating reliable output for optical character readers.

Using the resident draft mode in IBM emulation, the 2390 delivered a respectable 112 cps at 10 cpi. LQ output was distinctly better than that supplied by the 2380, and the 2390 managed a full 53 cps at 10 cpi. Once again, the wide-carriage model 2391 did not suffer any speed or print degradations compared with its nar-

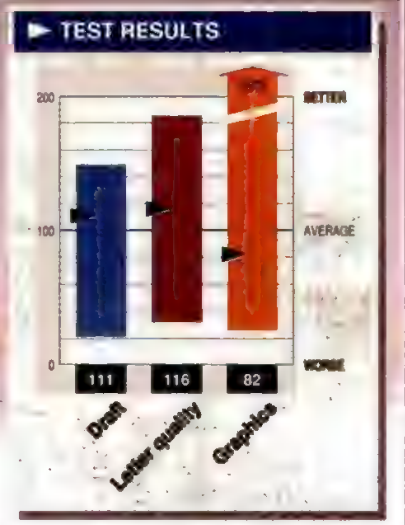
IBM Personal Printer Series II 2390



24-pin scores

In Short: With no difference in price from its 9-pin counterpart, the $499 narrow-carriage IBM Personal Printer Series II 2390 is the IBM to buy for 24-pin quality and features.

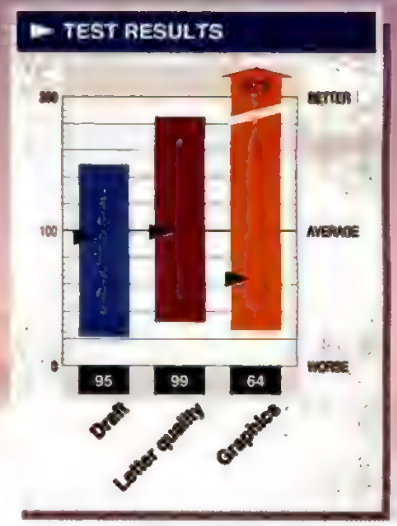
IBM Personal Printer Series II 2391



24-pin scores

In Short: Also priced identically to its 9-pin cousin, the $699 wide-carriage IBM Personal Printer Series II 2391 offers 24-pin output quality and more resident fonts.

IBM Proprinter 24P



24-pin scores

In Short: A rehash of IBM's old Proprinter line, the $499 24-pin narrow-carriage IBM Proprinter 24P offers improved paper handling and a large number of resident typefaces.

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Each model comes standard with serial and parallel interfaces, plus DEC LA120 and Epson FX emulations. The XL400 also comes standard with IBM Proprinter emulation, as well as bar code/OCR capabilites.* Other options include IBM coax and twinax interfaces.

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row-carriage companion, scoring a fleet 120 cps in draft mode and managing 56 cps in LQ mode.

The 2390's and 2391's IBM graphics emulation resulted in images that demonstrated better gray-scale reproduction and more-even tones than the 2380 and 2381 models. Slow graphics speeds—0.9 gppm for both machines—were caused by the same heat-sensing printhead technology as in the 2380 and 2381.

THE OLD DEAL

Announced in January of this year, the $499 Proprinter 24P is the one exception to IBM's new design. Its low, squat, narrow-carriage, 16- by 14-inch footprint resembles the popular IBM Proprinter X24E of the past. This screw-driven printer has 24 pins, comes with a 32K buffer and a Centronics parallel port, and has a maximum rated graphics resolution of 360 by 180 dpi. The familiar Proprinter six-button control panel on the 24P is simple, with separate buttons for font and pitch selection. The four remaining buttons operate paper-handling operations, including paper parking.

Adaptability is not the watermark of this printer. It offers only one emulation—IBM Proprinter, of course—and receives continuous forms in a rear U-fold push-tractor path (a $69 pull tractor is optional). It will handle only three-part forms (with a maximum thickness of 0.31 mm.), while allowing individual cut sheets and envelopes to be fed through the front. The only other option available for the Proprinter 24P is a $199 100-sheet bin feeder.

The one area where this printer does offer flexibility is in typefaces. There are seven resident fonts: Courier, Draft, Gothic, Orator, Presentor, Prestige, and script. In the characters-per-second race, the Proprinter 24P yielded 102 cps in draft at 10 cpi. Draft print is clean and concise. The only other print mode is LQ, where the Proprinter 24P—still with excellent print quality—turned in a slower 47 cps at 10 cpi. On the graphics speed test, the Proprinter 24P turned in a tardy 0.7-gppm score, and the bitmapped renderings of PC Labs' test image exhibited fewer gray shades than one would like to see from a 24-pin printer.

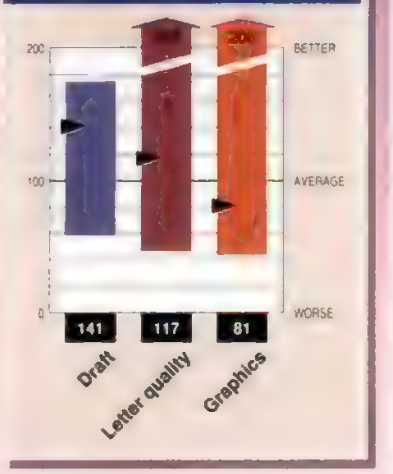
LOWERING THE STAKES

By midsummer, IBM/Lexmark was already busy filling orders for its new printers. Though they could not predict what dealers might be offering in the way of discounts, a company spokesperson did expect street prices to adhere closely to the suggested list prices, at least initially. If that is accurate, the friendly Series II printers will face rough competition from the likes of the dealer-discounted Panasonic units (reviewed in this issue), whose fine LQ print and new Super Quiet mode may sway many users.

Nonetheless, IBM/Lexmark has played a solid hand with this new group of printers. Lexmark's independence has not dulled the shining armor of a two-year parts-and-labor IBM warranty, though customers must still carry their purchases to an authorized dealer or IBM service center. (The single exception here is the 4226, for which IBM offers a one-year parts-and-labor warranty with free on-site service.) For IBM followers who like the old Proprinters, there is the updated Proprinter 24P. For buyers who want better paper handling and down-and-dirty multipart-forms printing, the 2380 or 2381 will do the job without chewing up reams of paper. You can get better print quality from the 2390 or 2391, however, and given that the list prices are the same as those for the 2380 and 2381, most users will find that the 24-pin models are a more attractive, cost-efficient choice.

IBM 4226 Printer

TEST RESULTS



9-pin scores

In Short: The $2,295 9-pin wide-carriage IBM 4226 Printer is a great choice for ultrafast high-volume printing.

FACT FILE

IBM Corp./Lexmark, 740 New Circle Rd., Lexington, KY 40511; 800-426-2468.

EDITORS' CHOICE

IBM 4226 Printer
List Price: $2,295.
Standard Warranty: One year on parts and labor with free on-site service.
Dimensions (HWD): 12 x 25 x 11 inches.
Weight: 46 lbs.
Emulations: Epson DFX, IBM Proprinter.

IBM Personal Printer Series II 2380
List Price: $499; 32K memory upgrade, $55; 150-sheet cut-sheet feeder, $199.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 10 x 19 x 15 inches.
Weight: 15 lbs.
Emulations: Epson FX, IBM Proprinter.

IBM Personal Printer Series II 2381
List Price: $699; 32K memory upgrade, $55; 150-sheet cut-sheet feeder, $239.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 10 x 25 x 15 inches.
Weight: 19 lbs.
Emulations: Epson FX, IBM Proprinter.

IBM Personal Printer Series II 2390
List Price: $499; 32K volatile-memory upgrade, $55; 32K nonvolatile-memory upgrade, $79; font disk, $35; 150-sheet cut-sheet feeder, $199.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 10 x 19 x 15 inches.
Weight: 15 lbs.
Emulations: Epson LQ, IBM Proprinter.

IBM Personal Printer Series II 2391
List Price: $699; 32K volatile-memory upgrade, $55; 32K nonvolatile-memory upgrade, $79; font disk, $35; downloadable fonts, $35; 150-sheet cut-sheet feeder, $239; serial interface, $125.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 10 x 25 x 15 inches.

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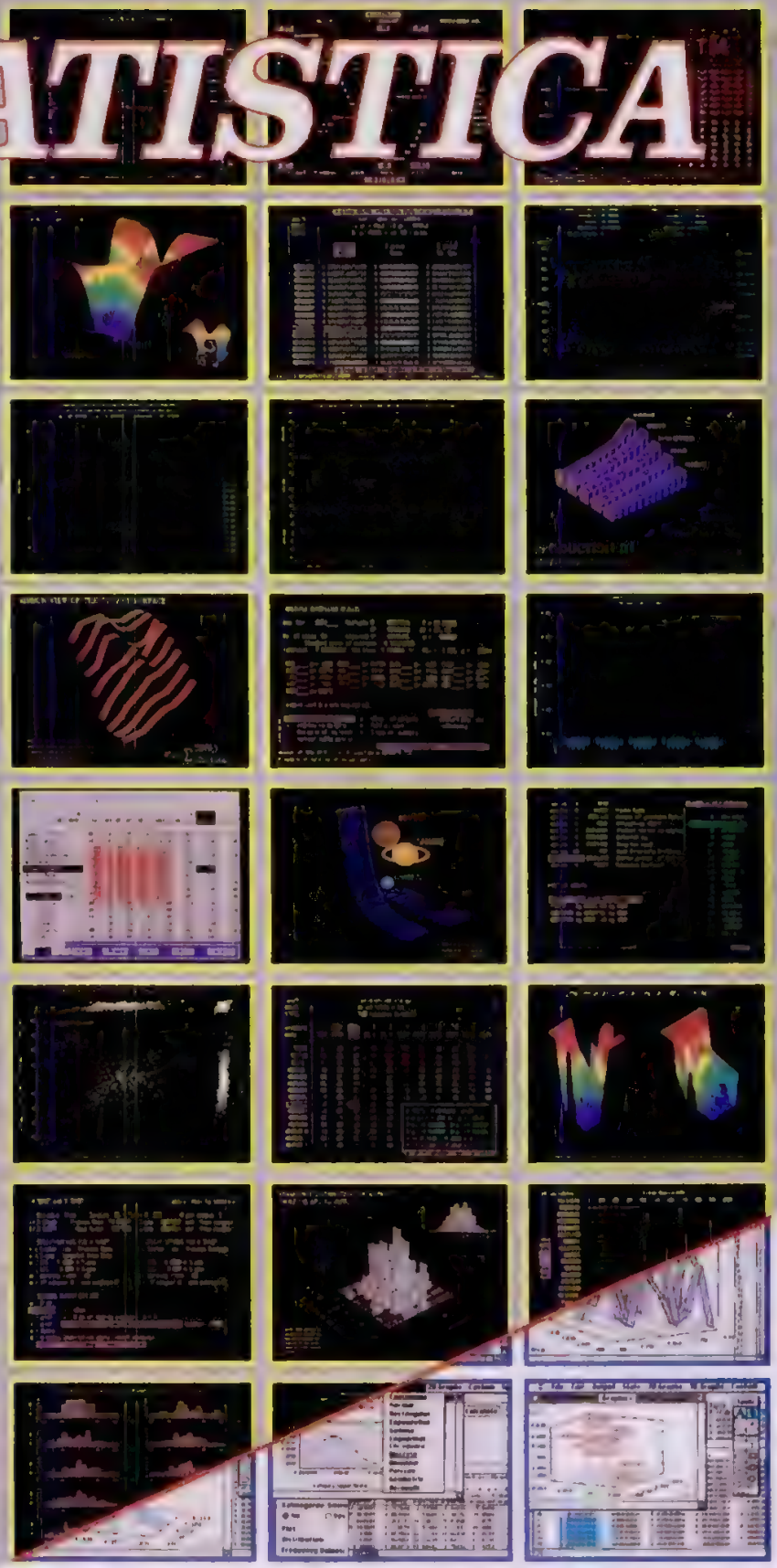

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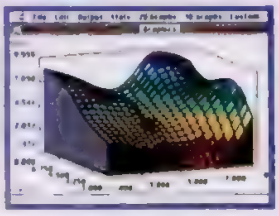

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Weight: 19 lbs.
Emulations: Epson LQ, IBM Proprinter.

IBM Proprinter 24P
List Price: $499; pull tractor, $69; 100-sheet cut-sheet feeder, $199.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 5 x 16 x 14 inches.
Weight: 18 lbs.
Emulations: IBM Proprinter.

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MANNESMANN TALLY CORP.

Mannesmann Tally MT82

Mannesmann Tally MT661

by Wendy Dugas Pérez

Last year, Mannesmann Tally Corp. introduced both the MT130/9 and the MT131/9 as 9-pin office workhorses. In 1991, the company added significant paper-handling features to these two machines, including optional pull tractors for bottom feed of seven-part continuous forms, as well as a now-standard auto quick-tear feature. Mannesmann Tally's new offerings this year include the $499 24-pin narrow-carriage MT82, geared toward lighter office duties such as word processing, and the $6,999 66-pin MT661 line printer, designed for heavy-duty data processing and industrial graphics. While the MT82 was able to outpace last year's 9-pin printers in text and graphics speed (and is priced below them as well), it is still bothered by a few handicaps.

THE MT82

The MT82, a lightweight 24-pin dot matrix printer, is a small package measuring 10 by 16 by 12 inches with all options installed. Boasting paper-handling features that include both a push tractor for continuous forms and a built-in sheet feeder, the MT82 also provides you with automatic paper parking and a quick-tear function. Although it comes with a parallel interface, you can purchase a serial interface for $45. And even though it offers only two emulations—Epson LQ and IBM Proprinter—these are probably the only two you are likely to need. Its shortage of fonts could be more of a drawback, though, as the MT82 is only capable of draft, sans serif, and Times Roman.

The print quality of the MT82's few fonts leaves a little to be desired as well. There is banding on the graphics as well as some smearing. All of our efforts to move the paper closer to the platen could not significantly reduce the smearing effect. On PC Magazine Labs' speed tests, the MT82 also came up short, turning in mediocre times—73 characters per second in IBM Proprinter draft mode and 39 cps in letter-quality mode.

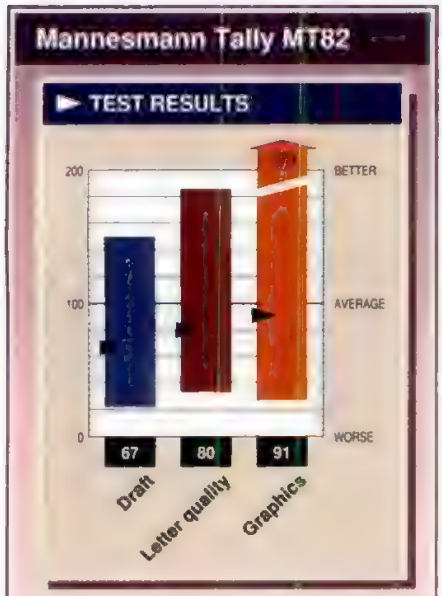
▪ Mannesmann Tally MT661

Finally, Mannesmann Tally would do well to rethink the layout of its manual. Although the manual generously includes instructions in five languages, it is very difficult to follow because it gives you instructions in all five languages at once. A better solution would be to divide the documentation into different sections.

THE MT661

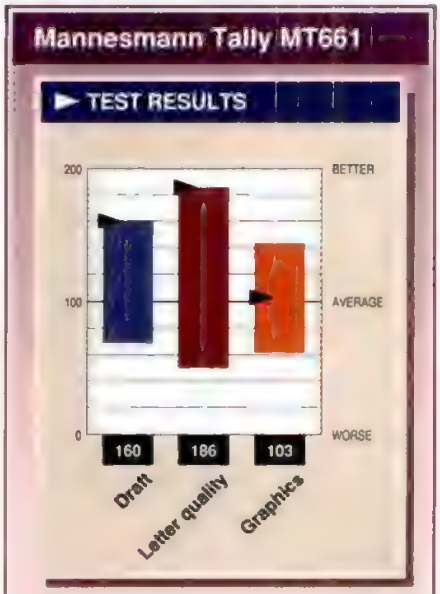
The MT661, a line printer rated at 800 lines per minute, is a modernized version of the MT645 we reviewed in last year's special printer issue. Pricing on the MT661 is dependent on the type of stand desired. The base-priced unit sells for $6,999 (add $199 more if you want the optional printer stand). A price of $7,499 includes a pedestal, and for the grand total of $7,999, you can also purchase a sound-dampening stand, with which the company rates the MT661 at 55 dB.

The MT661's control panel uses a 16-character LCD, which lets you easily menu through the printer's options and features. It has Epson FX and IBM Proprinter emulations, along with Mannesmann Tally MT660/690 and Printronix P6000 emulations. With the Graphics Processing option ($800), you get full QMS Code V



24-pin scores

In Short: The $499 24-pin narrow-carriage Mannesmann Tally MT82 is small and relatively inexpensive, but its graphics output is lacking in quality.



Line-printer scores

In Short: The $6,999 Mannesmann Tally MT66 line-printer is rated at a blinding 800 lines per minute and is an excellent choice for networks and industrial printing.

▪ Mannesmann Tally MT82

Version 2 compatibility, which aids in the printing of forms, bar codes, labels, OCR characters, and other industrial graphics.

Besides speed, one of the prime advantages of the MT661 is that it has serial and parallel interfaces resident, and you can simultaneously enable both ports at the same time. This is of obvious help when you use the printer for network printing.

One of its disadvantages is that on PC Labs' graphics speed test, the produced image was consistently too dark. Attempts to change the distance between the printhead and the paper also met with defeat. However, the MT661 was able to produce graphics and text output at a blinding rate. It was the fastest of all the line printers, at 467 cps in Epson draft mode and an amazing 227 cps in LQ mode.

Both printers are covered by a 90-day on-site service policy, along with the option of purchasing an extended warranty. The MT82 has price and size going for it, as well as decent text printing and speed. But its small selection of fonts and imperfect graphics printing quality leave something to be desired. As for the MT661, if you have a heavy workload and need the impressive speed ability it offers, it's a good choice.

FACT FILE

Mannesmann Tally Corp., 8301 S. 180th St., Kent, Washington 98032; 206-251-5520.

EDITORS' CHOICE

Mannesmann Tally MT661
List Price: $6,999; with pedestal, $7,499; with soundproofing cover, $7,999; regular paper stand for base-priced model, $199; Graphics Processing option, $800.
Standard Warranty: 90 days on parts and labor with on-site service.
Dimensions: 44 x 32 x 22 inches.
Weight: 77 lbs.
Emulations: Epson FX, IBM Proprinter, Mannesmann Tally MT660/690, Printronix P6000.

Mannesmann Tally MT82
List Price: $499; serial interface, $45.
Standard Warranty: 90 days on parts and labor with on-site service.
Dimensions: 10 x 16 x 12 inches.
Weight: 13 lbs.
Emulations: Epson LQ, IBM Proprinter.

CIRCLE 405 ON READER SERVICE CARD

NEC TECHNOLOGIES INC.

NEC Pinwriter P3200
NEC Pinwriter P3300
NEC Pinwriter P9300

by Winn L. Rosch

An old hand at PC printers, NEC Technologies has been making desktop print-

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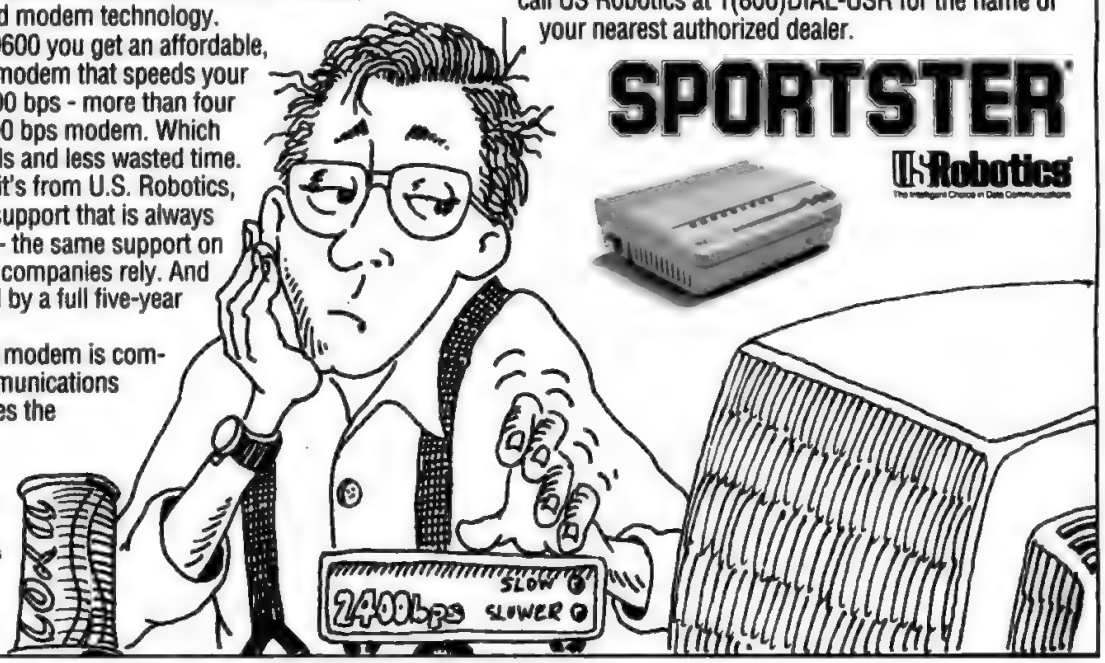

* For internal version. $645 for external version. Sportster 9600 modems come with trial offers from CompuServe® and Prodigy®. Internal version includes communications by Crosstalk®. Registered Trademarks: MNP; Microcom Inc., CompuServe; CompuServe, Prodigy; Prodigy, Crosstalk; DCA.

CIRCLE 231 ON READER SERVICE CARD

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FLAT-OUT-RELIABLE IBM PPS II

FACT FILE

Panasonic Communications & Systems Co., Two Panasonic Way, Secaucus, NJ 07094; 800-742-8086; 201-348-7000.

Panasonic KX-P1123
List Price: $369.95; 80-sheet cut-sheet feeder, $149.95; serial interfaces, $69.95 and $109.95; 32K buffer chip, $75.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 5 x 16 x 13 inches.
Weight: 16 lbs.
Emulations: Epson LQ, IBM Proprinter.

Panasonic KX-P1124I
List Price: $499.95; 100-sheet cut-sheet feeder, $169.95; serial interfaces, $69.95 and $109.95; 32K buffer chip, $75.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 6 x 17 x 14 inches.
Weight: 19 lbs.
Emulations: Epson LQ, IBM Proprinter.

EDITORS' CHOICE

Panasonic KX-P2624
List Price: $699.95; 100-sheet cut-sheet feeder, $239.95; serial interfaces, $69.95 and $109.95; 32K buffer chip, $75.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 7 x 23 x 16 inches.
Weight: 34 lbs.
Emulations: Epson LQ, IBM Proprinter.

CIRCLE 408 ON READER SERVICE CARD

PRINTRONIX

Printronix P3240

by Joseph Desposito

With a suggested retail price of $6,345, the Printronix P3240 is not your average dot matrix printer. Actually, this printer and the others in the Printronix 3000 Series line are matrix printers; they use a device with 34 print hammers arranged in a line resembling the Rockettes across a stage.

The P3240's parent, the P3040, is a pedestal model. The P3240 is a floor-cabinet model with specifications similar to the P3040. In all, the Printronix P3000 Series has three models: The other one is the P3040-12. This one uses a smaller hammer tip of 0.012 inches to produce very fine bar-code print quality. The standard hammer has a 0.016-inch diameter.

Printronix sells through major OEMs, authorized distributors, and VARs. The printers, rated at 400 lines per minute, are obviously capable of handling heavy printing demands. But Printronix also sells many printers for bar-code label printing. The P3000 Series printers are Postnet-certified by the U.S. Postal Service.

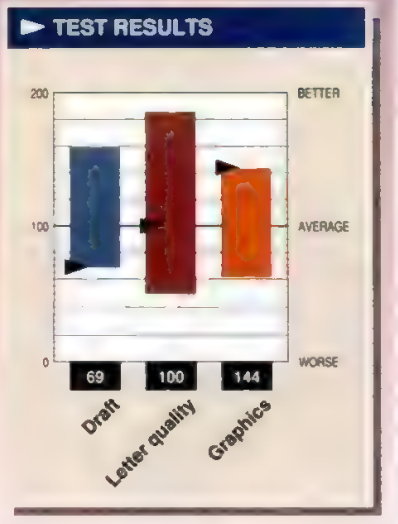
LARGE AND NOISY

The P3240 is a line matrix printer about the size of a washing machine. It rumbles, too, since the assembly of hammers that produces the dots is installed on an oscillating shuttle. This is a noisy operation, but the P3240 cabinet is soundproofed with 0.8-inch insulation to produce a company-claimed sound rating of 52 decibels.

The P3240 has two control panels, one on the top of the cabinet and one inside. The inside panel has eight buttons and an LCD readout, which is a bit complicated to use, and the printer's documentation has confusing diagrams of the menuing system. To combat these difficulties, Printronix includes a software simulation of the panel on a floppy disk.

To load paper, you open the front cabinet door, lay the paper on the cabinet floor, and feed it up through the bottom of the printer. After the paper feeds through, it lies on the floor at the back of the cabinet, and you retrieve it through a back cabinet door. The P3240 easily handles thick multipart forms and heavy paper stock. A Centronics interface at the back of the unit can be replaced with a serial or Dataproducts interface.

Printronix P3240



Line-printer scores

In Short: One of four line printers reviewed, the $6,345 Printronix P3240 delivers only a typical features set and below-average line-printer speed.

INTELLIGENT GRAPHICS PROCESSOR

The review unit contained an Intelligent Graphics Processor (IGP) board that costs an additional $995. The board lets you create and store forms or generate logos, bar codes, expanded characters, and other graphics. Unfortunately, the board interfered with PC Magazine Labs' IBM Graphics Printer emulation test when the test sent the characters to the printer. Printronix tech support advised us to send the character string "QUIET" to the printer before using the emulation. The P3240 also has a P-series emulation.

On PC Labs' text speed test, the printer performed at 122 characters per second in its IBM Proprinter draft mode—the slowest of the four line printers we reviewed here. This is also quite a bit lower than the rated speed, but the test is not designed to take full advantage of the line matrix printer's capabilities. On the graphics speed test, the printer posted a fast 4.9 graphics pages per minute.

The P3240 prints in data processing, high speed, and near-letter-quality modes. NLQ mode, although well defined, is not attractive. On the graphics speed test,

the dots were too large to produce a good image, but the black areas were very dark and no streaking was evident.

The Printronix P3240 is typical of the line printers reviewed here as far as features go. Its disappointing text performance is offset only slightly by its sound-dampening cabinet and bar-coding ability, since Mannesmann Tally's MT661 has the same features and about twice the speed.

FACT FILE

Printronix, 17500 Cartwright Rd., P.O. Box 19559, Irvine, CA 92713; 800-826-3874, 714-863-1900.
Printronix P3240
List Price: $6,345; Intelligent Graphics Processor, $995.
Standard Warranty: 90 days on parts and labor with on-site service option.
Dimensions (HWD): 42 x 27 x 29 inches.
Weight: 210 lbs.
Emulations: IBM Graphics Printer, IBM Proprinter, Printronix P-series.

CIRCLE 409 ON READER SERVICE CARD

SEIKOSHA AMERICA INC.

Seikosha LT 20

Seikosha BP 5780

by Kellyn Betts

One of the odd couples of this year's printer project is Seikosha America's portable $499 LT 20 and heavy-duty $2,200 BP 5780. The two printers really have little more than a boxy shape in common. The princely 24-pin portable printer, the LT 20, is aimed at the laptop-using elite, while its 18-pin cousin, the BP 5780, is clearly a proletarian printer for those who have to share their resources.

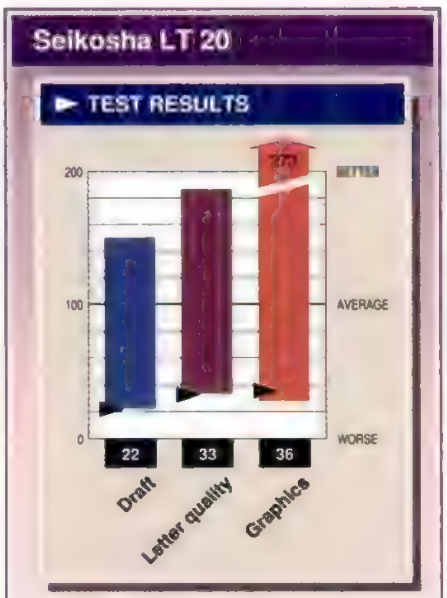
THE LT 20

The LT 20 certainly constitutes a unique approach to the portable-printer problem. It is designed to serve as an under-your-laptop printer. Accordingly, its small and flat case resembles a platform for the laptop. Paper shoots out the printer's right side after slowly passing beneath the 24-pin printhead. The LT 20 emulates only an IBM Proprinter, and even its fastest draft speed—which is very dotty—is but a laggardly 23 characters per second, according to PC Magazine Labs' text speed test. Letter-quality mode was a leaden 16 cps.

These speed results are not bad for a portable, of course, and the printer's status as the first 24-pin portable would mitigate far more terrible sins. Its printhead provides LQ output that is certainly worth the wait, too. The output quality may be a bit lighter than you might want, but it is definitely as legible as can be. The same goes for the printer's graphics output, which is slightly marred by a tendency to streak. The fact that the paper is fed from a 50-sheet-capacity bin is a sell in itself.

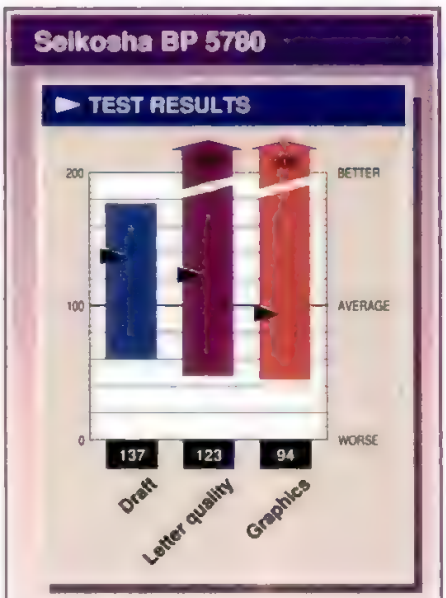
But is this printer too big to be portable? Its 30-pound weight would double the weight of most portables, and its bulk could make the load even more cumbersome. Seikosha's solution comes in the form of a $74.99 carrying case sized generously enough to contain the laptop PC and printer, as well as some accessories. Fully loaded, it is a little cumbersome, but for general transportation purposes, the weight and packaging should be more than acceptable.

Like most laptop computers, the LT 20 comes with a plethora of options and accessories. The base-priced unit comes with only an AC power supply. A $549 version



24-pin scores

In Short: A new approach to the portable printer, the $499 narrow-carriage Seikosha LT 20's slow 24-pin performance is only mitigated by its ability to handle multipart forms on the road.



18-pin scores

In Short: Although the $2,200 ultrafast 18-pin wide-carriage Seikosha BP 5780 has potential, its present flaws remove it from the running.

of the portable can use AA or Sub-C batteries, provided that you buy extra-cost kits (between $50 and $122). Extra RAM and ROM options ($29.99 each) will buy you not only eight additional typefaces (beyond the one that comes standard) but also extra print buffer space.

BP 5780

The BP 5780 is a printer for frequent forms users. Its forte is to press multiple layers (up to seven sheets) of carbon-filled and carbonless forms continuously at moderate speeds. For variety, you can use the built-in sans serif or Times Roman font instead of draft, though you will pay a speed penalty.

although the BP 5780 was easy to use, we did encounter some problems. The paper-width setting in ROM made it difficult to perform the edge-to-edge test.

Changing fonts, as well as 40 other printing characteristics, is easy with this printer. A 16-character LCD and a logically organized control panel and setup mode are the reason. The BP 5780 has four different emulations—if you count the two flavors of its Seikosha BP 5460 emulation separately—and it can store up to three groups of settings for use with different forms and applications.

Although the printer was easy to use, we encountered some problems during testing. The paper-width setting in ROM worked exactly opposite of how it should, making it quite difficult to perform the edge-to-edge test. Furthermore, the IBM Proprinter emulation failed to call up the LQ fonts based on the instructions outlined in the manual. On the other hand, the Epson emulation had no problem doing so. Also, the IBM emulation exhibited some registration problems on our graphics speed test.

Though we experienced problems with both of the Seikosha printers that we tested, it is only fair to mention that the company has a fairly generous service policy. The two-year parts-and-labor warranty is implemented through the company's network of authorized service centers and is backed up by a toll-free technical support line. Also, an OEMed version of the BP 5780 is marketed by Dataproducts as the 8500 printer for the same $2,200 price.

Any and all laptop-using executives and professionals should consider adding Seikosha's new LT 20 to their portable collection. Try it out, at least. But stay away from the BP 5780, at least until it gets a ROM upgrade, or consider taking a close look at the Dataproducts 8500 if a forms-intensive printer is more your speed.

FACT FILE

Seikosha America Inc., 10 Industrial Ave., Mahwah, NJ 07430; 800-338-2609, 201-327-7227.

Seikosha LT 20

List Price: $499; with AA disposable battery and rechargeable battery capacity, $549; with AA disposable battery and rechargeable battery kit with trickle charger, $142.99; trickle charger for Sub-C and AA battery packs (no AC during charging), $46.99; trickle charger for Sub-C and AA battery packs (with AC power during charging), $121.99; cigarette-lighter adapter, $99.99; ROM to expand the number of fonts from one to nine, $29.99; RAM expansion chip to 32K, $29.99; carrying case, $74.99.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 2 x 15 x 11 inches.
Weight: 6 lbs. (without battery), 8 lbs. (with battery).
Emulations: IBM Proprinter.

Seikosha BP 5780

List Price: $2,200; font card, $29.99.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 10 x 24 x 12 inches.
Weight: 44 lbs.
Emulations: Epson FX, IBM Proprinter, Seikosha BP 5460.

CIRCLE 410 ON READER SERVICE CARD

STAR MICRONICS AMERICA INC.

Star Micronics NX-1001 Multi-Font
Star Micronics NX-1020 Rainbow
Star Micronics NX-2420 Multi-Font
Star Micronics NX-2420 Rainbow
Star Micronics XB-2420 Multi-Font
Star Micronics XB-2425 Multi-Font
Star Micronics XR-1020 Multi-Font
Star Micronics XR-1520 Multi-Font

by Bruce Brown

To make money selling dot matrix printers, a vendor must offer temptingly priced printers that combine adequate print quality, effortless paper handling, multiple fonts, and acceptable speed. Star Micronics America's printers do well in each aspect. With 13 different models with retail prices ranging from $229 to $949 and discounts of up to 40 percent, Star Micronics is the second-highest-volume dot matrix printer manufacturer in the world, following only Epson America. The company introduced eight of its current models this year, with newly designed cases, new print mechanisms, and added functions.

These eight new printers include four 9-pin models (the $229 narrow-carriage NX-1001 Multi-Font, the $299 narrow-carriage NX-1020 Rainbow, the $549 narrow-carriage XR-1020 Multi-Font, and the $699 wide-carriage XR-1520 Multi-Font) and four 24-pin models (the $449 narrow-carriage NX-2420 Multi-Font, the $499 narrow-carriage NX-2420 Rainbow, the $749 narrow-carriage XB-2420 Multi-Font, and the $949 wide-carriage XB-2425 Multi-Font).

All but the low-end NX-1001 Multi-Font do away with mechanical DIP

switches entirely, using an electronic DIP-switch system for selecting and setting printer parameters and power-on defaults via the front-panel buttons. All the new Star Micronics printers have a single button-selectable quiet mode, which cuts printing speed slightly but noticeably quiets the printing process.

Star Micronics sells to a variety of markets, but its current focus for dot matrix printers is home offices. The company believes the home-office market consists of businesses run from homes, employees who bring work home after hours, and telecommuters. This market is rapidly growing, estimated to include 20 million households this year and more than 40 million households by 1995.

THE NX-1001 MULTI-FONT

At $229 retail, the NX-1001 Multi-Font is the least expensive printer in Star Micronics' new line. This 9-pin narrow-carriage printer sells for as little as $126 on the street and has the most limited feature set of any new Star Micronics printer. It has, for example, no bottom paper feeding (often preferred for multipart forms) and only four resident near-letter-quality fonts (Courier, Orator, Orator-2, and sans serif). There is an optional $99 light-duty sheet feeder that handles up to 50 sheets of paper in a single bin.

The two NX-1001 Multi-Font printer emulations are Epson LX and IBM Proprinter. The unit supports automatic paper loading, and its front panel has separate buttons for font and pitch selection, including condensed and proportional print. Selectable pitch and font locking let you override commands sent via application software.

Print quality for text and graphics is acceptable for a 9-pin printer. The printing speed is also as expected but unspectacular, rated at 150 characters per second in 10-character-per-inch draft mode, but the unit turned out 97 cps on PC Magazine Labs' text speed test. NLQ mode, rated at 38 cps, came in at 26 cps.

THE NX-1020 RAINBOW

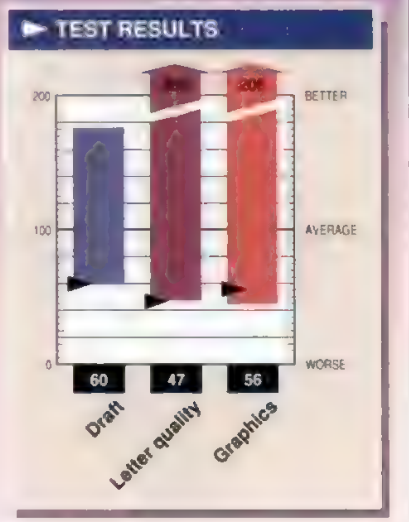
The NX-1020 Rainbow, Star Micronics' least-expensive color-capable 9-pin printer, replaces the NX-1000 Rainbow. With a list price of $299 and street price as low as $170, the NX-1020 Rainbow is a small step up from the NX-1001, but it offers several advantages over its even lower-end sibling.

In addition to added color-printing capability via an Epson FX emulation, the NX-1020 adds a high-speed draft mode, an EDS (Electronic Dip Switch) menu, a standard internal push/pull tractor feed, and bottom feeding. Standard draft and NLQ speed ratings are the same as for the NX-1001 Multi-Font, and there is the identical set of four NLQ resident fonts, but the added flexibility brought by the NX-1020 Rainbow's extra features is worth the price jump.

However, the NX-1020 Rainbow tested at speeds of only 96 cps in IBM Proprinter draft mode and 34 cps in NLQ mode. The high-speed draft mode, rated at 200 cps, provided only a slight increase over regular draft on PC Labs' test.

the added flexibility brought by the Star Micronics NX-1020 Rainbow's extra features is worth the price jump.

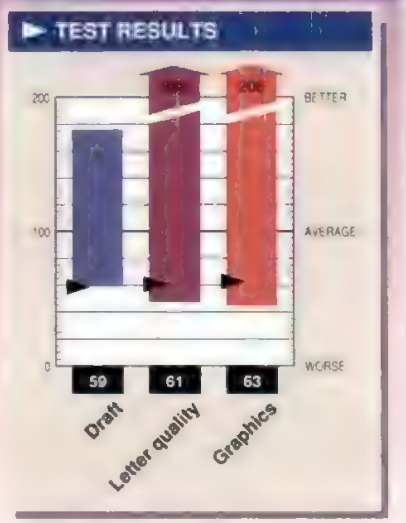
Star Micronics NX-1001 Multi-Font



9-pin scores

In Short: The $229 9-pin narrow-carriage Star Micronics NX-1001 Multi-Font is a good choice, especially because this low-end printer has smooth operation. With a street price as low as $126, it could be the cheapest printer here.

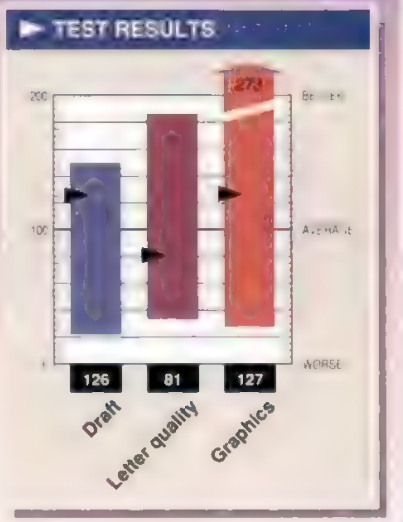
Star Micronics NX-1020 Rainbow



9-pin scores

In Short: The $299 9-pin narrow-carriage NX-1020 Rainbow is Star Micronics' least expensive color-capable printer (with a street price as low as $170). Its features include bottom paper feeding and a high-speed draft mode.

Star Micronics XB-2420 Multi-Font



24-pin scores

In Short: If you're looking for a font- and feature-laden 24-pin printer at a reasonable price, the $749 narrow-carriage color-capable Star Micronics XB-2420 Multi-Font delivers impressive quality.

The NX-1020 Rainbow's paper-handling options do, however, add significantly to its utility. The built-in push/pull internal tractor and $50 optional external pull tractor enable the bottom-feed slot and allow for smoother handling of multipart forms.

THE XR-1020 MULTI-FONT AND XR-1520 MULTI-FONT

If 9-pin print quality is sufficient but you need faster performance than the Star Micronics low-end 9-pin printers provide, the narrow-carriage XR-1020 Multi-Font and wide-carriage XR-1520 Multi-Font printers are a good buy. With list prices of $549 and $699, respectively, these printers are especially well positioned as workhorse machines. Both units will print in color with an optional $20 color ribbon.

The XR-1020 and XR-1520 Multi-Font printers are Epson FX– and IBM Proprinter–compatible. Each has a 32K print buffer and a total of seven resident NLQ fonts, as well as draft and high-speed draft fonts. The NLQ fonts are Courier, Helvetica, Orator, Prestige, sans serif, script, and Times Roman, all printable in ten pitches from 2.5 to 20 cpi, and all but script are in proportional pitch.

Both the XR-1020 Multi-Font and the XR-1520 Multi-Font are a big step up in rated and tested speeds from the lower-cost Star Micronics 9-pin models. Rated at 70 cps in 10-cpi NLQ mode and 280 cps in draft mode, the actual test results were about 57 cps in NLQ mode and 137 cps in draft.

Both printers can feed from the back, from the top, and from the bottom. The built-in tractor is push-style only, but a $50 optional external pull tractor makes quick work of bottom-fed multipart forms—although when we fed five-part forms through, the rear feed worked without binding. The narrow-carriage model accepts paper up to 11.7 inches wide, and the wide version can handle paper widths up to 16.5 inches. Both the $149 narrow-carriage and $199 wide-carriage 50-sheet-capacity single-bin automatic sheet-feeder were easy to attach and worked fine during testing.

THE NX-2420 MULTI-FONT

A step up in print quality is Star Micronics' NX-2420 Multi-Font—a narrow-carriage printer that lists for $449 and sells on the streets for as little as $269.

Printer emulations for the NX-2420 Multi-Font include the Epson LQ and IBM Proprinter. In addition to regular and high-speed draft fonts, there are five resident NLQ fonts: Courier, Prestige, sans serif, script, and Times Roman. There are also 4 optional font cards ($99 each) with an additional 2 to 4 fonts each. In addition to proportional spacing, this printer lets you select from 13 different character pitches.

No one will buy the NX-2420 Multi-Font for speed. It ran PC Magazine Labs' standard text speed test at 94 cps in IBM Proprinter draft and a lowly 43 cps in LQ mode. Speed is not what counts here but text and graphics print quality, which is noticeably better than that produced by Star Micronics' 9-pin printers.

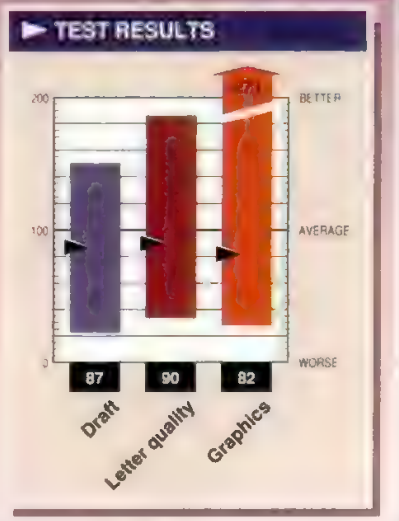
The NX-2420's paper-handling choices include top, rear, or bottom paper feeding, with a standard internal push/pull tractor standard. Options include a $55 paper-roll holder and a $99 50-sheet single-bin cut-sheet feeder.

THE NX-2420 RAINBOW

With the same model number but different surname than the NX-2420 Multi-Font, the NX-2420 Rainbow lists for $499 (figure a street price around $299) but adds an Epson LQ color emulation and a larger 30K print buffer.

The NX-2420 Rainbow is a narrow-carriage 24-pin printer with top, rear, and

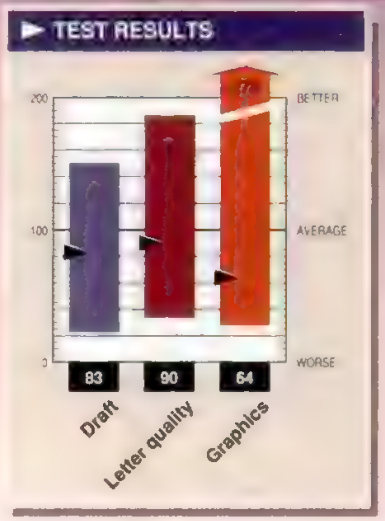
Star Micronics NX-2420 Multi-Font



24-pin scores

In Short: The $449 narrow-carriage Star Micronics NX-2420 Multi-Font gives you slow but good-looking 24-pin output and is a simple-to-use printer.

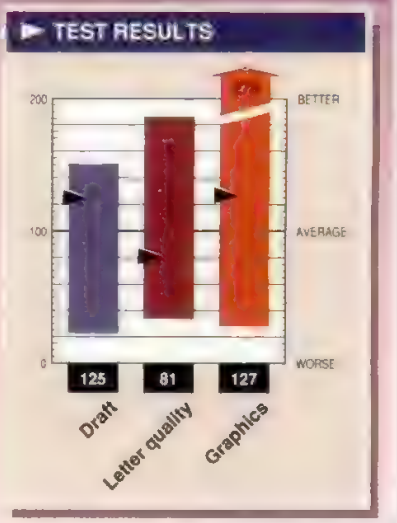
Star Micronics NX-2420 Rainbow



24-pin scores

In Short: The $499 24-pin narrow-carriage Star Micronics NX-2420 Rainbow moves one step ahead of its sibling, the NX-2420 Multi-Font, by adding color capability and a larger buffer.

Star Micronics XB-2425 Multi-Font



24-pin scores

In Short: Another high-quality 24-pin printer, the $949 color-capable Star Micronics XB-2425 Multi-Font is the wide-carriage brother of the XB-2420 Multi-Font.

Printers for people who want to look as good at home as they do in the office.

When you put your ideas on paper, they have to make a great impression. And that's a given, with either of these two new Panasonic* printers. Because both offer the impressive value and performance you'd expect from the people who make the industry's best-selling 24-pin printer.*

The KX-P1124i, the office model, gives you 11 built-in fonts, including Super Letter Quality for an exceptionally professional appearance. You also get the versatility of bottom, front and rear paper paths. 300 cps draft speed. And a new LCD display on the EZ™ Set control panel that takes "user friendly" to a new level. For the price, there isn't another printer on the market that even comes close.

The KX-P1123 brings home nearly the same capabilities, at a price that's even more affordable. It has 7 fonts, three paper paths, EZ Set front panel, and 240 cps draft speed. Plus a new automatic microline feed that makes paper loading a cinch.

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* The Panasonic KX-P1124. Based on US dollar share of competitive models for the 12 months ending December, 1990, as reported by InfoCorp. (1/91).

P6-PC

CIRCLE 122 ON READER SERVICE CARD

bottom feeding, an internal push/pull tractor feed, five NLQ fonts, and the same slow printing speed resulting in good print quality.

All the NX-2420 Multi-Font's fonts, pitches, and options are available here as well, making the NX-2420 Rainbow a low-end 24-pin narrow-carriage printer with just a little bit extra.

THE XB-2420 MULTI-FONT AND XB-2425 MULTI-FONT

The high end of Star Micronics' 24-pin dot matrix line is the XB-2420 and XB-2425 Multi-Font printers. The $749 ($442 street price) narrow-carriage XB-2420 Multi-Font and $949 ($560 street price) wide-carriage XB-2425 Multi-Font add good speed for 24-pin printers, flexible paper handling, and more fonts than you will need. Both printers also include color capability and come with a color ink ribbon cartridge.

Other than the ability to handle wider paper than the XB-2420 Multi-Font (16.5 inches maximum versus 11.7 inches), the only difference found in the XB-2425 Multi-Font is a larger print buffer: 76K versus the XB-2420 Multi-Font's 29K.

the XB-2420 and XB-2425 are the only dot matrix printers Star Micronics sells with LCD front-panel menu screens.

These are the only new dot matrix printers Star Micronics sells with an LCD front-panel menu screen, in this case a 16-character device. It is with this screen and the EDS menu mode that you can select the Epson LQ or IBM Proprinter emulation, or any of the prodigious number of fonts.

Of the 27 resident fonts, there are two draft (regular and high-speed), four SLQ (super letter quality), and 21 NLQ fonts. The quantity of LQ fonts is reduced somewhat if proportional-pitch versions are not counted separately, but you still end up with Times Roman and TW-Light in SLQ, and Blippo, Cinema, Courier, Helvetica, Letter-G, Orator, Orator-2, Prestige, sans serif, script, and Times Roman fonts in NLQ mode. If that is not enough, additional NLQ and SLQ font cards are available for $99 each. The print quality is uniformly smooth.

While the XB-2420 and XB-2425 Multi-Font printers don't produce blazing speeds compared with 9-pin printers, they hold their own against other 24-pin printers. Their text speed test results were highly respectable, at about 135 cps in regular IBM Proprinter draft mode and about 39 cps in LQ mode.

You can feed the printers from the top, rear, or bottom. A standard internal push tractor can be augmented by a $50 external pull tractor for using multipart forms via the bottom-feed slot. A 70-sheet single-bin cut-sheet feeder is an extra $149 for the narrow-carriage version and $199 for the wide version.

Star Micronics printers are widely sold via dealer and direct selling channels. All

printers come with a two-year parts-and-labor warranty, with service available from authorized service centers.

The new Star Micronics dot matrix printers present a full selection of reasonably priced printers. If lasers don't give you the paper-handling flexibility you need, or if you just need one or more extra printers for office or home use, it is hard to see how you would be disappointed by any of the eight printers in the Star Micronics line.

Star Micronics presents a full selection of inexpensive printers.

FACT FILE

Star Micronics America Inc., 420 Lexington Ave., #2702, New York, NY 10170; 800-447-4700, 212-986-6770.

Star Micronics NX-1001 Multi-Font
List Price: $229; 50-sheet cut-sheet feeder, $99.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 5 x 17 x 16 inches.
Weight: 11 lbs.
Emulations: Epson LX, IBM Proprinter.

Star Micronics NX-1020 Rainbow
List Price: $299; 50-sheet cut-sheet feeder, $99; external pull tractor, $50; paper-roll holder, $55.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 6 x 19 x 17 inches.
Weight: 14 lbs.
Emulations: Epson EX, Epson FX, IBM Proprinter.

Star Micronics NX-2420 Multi-Font
List Price: $449; pull tractor, $50; font cards, $99 each; 50-sheet cut-sheet feeder, $99; 32K buffer with battery backup, $49; paper-roll holder, $55.
Standard Warranty: Two years on parts and labor.
Dimensions: 7 x 19 x 14 inches.
Weight: 15 lbs.
Emulations: Epson LQ, IBM Proprinter.

Star Micronics NX-2420 Rainbow
List Price: $499; pull tractor, $50; font cards, $99 each; 50-sheet cut-sheet feeder, $99; 32K buffer with battery backup, $49; roll-paper holder, $55.
Standard Warranty: Two years on parts and labor.
Dimensions: 7 x 19 x 14 inches.
Weight: 15 lbs.
Emulations: Epson LQ, IBM Proprinter.

Star Micronics XB-2420 Multi-Font
List Price: $749; pull tractor, $50; font cards, $99 each; 70-sheet cut-sheet feeder, $149; 8K serial interface cartridge, $85; 32K buffer with battery backup, $49; 128K parallel interface cartridge, $139.
Standard Warranty: Two years on parts and labor.
Dimensions: 7 x 19 x 20 inches.
Weight: 22 lbs.
Emulations: Epson LQ, IBM Proprinter.

Star Micronics XB-2425 Multi-Font
List Price: $949; pull tractor, $50; font cards, $99 each; 70-sheet cut-sheet feeder, $199; 8K serial interface cartridge, $85; 32K buffer with battery backup, $49; 128K parallel interface cartridge, $139.
Standard Warranty: Two years on parts and labor.
Dimensions: 7 x 25 x 20 inches.
Weight: 27 lbs.
Emulations: Epson LQ, IBM Proprinter.

Star Micronics XR-1020 Multi-Font
List Price: $549; pull tractor, $50; 50-sheet cut-sheet feeder, $149; 8K serial interface cartridge, $85; 128K parallel interface cartridge, $139; color option, $20.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 7 x 19 x 20 inches.
Weight: 21 lbs.
Emulations: Epson FX, IBM Proprinter.

Star Micronics XR-1520 Multi-Font
List Price: $699; pull tractor, $50; 50-sheet cut-sheet feeder, $199; 8K serial interface cartridge, $85; 128K parallel interface cartridge, $139; color option, $20.
Standard Warranty: Two years on parts and labor.
Dimensions (HWD): 7 x 25 x 20 inches.
Weight: 26 lbs.
Emulations: Epson FX, IBM Proprinter.

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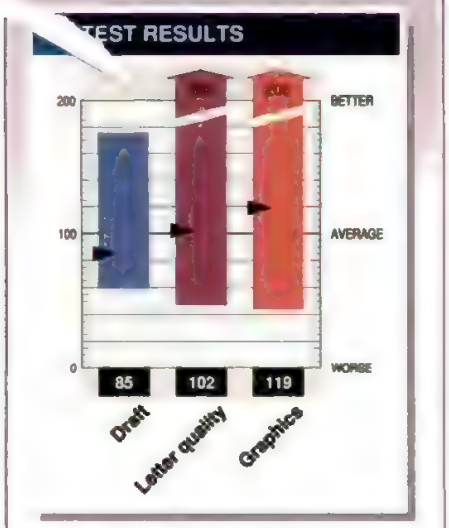
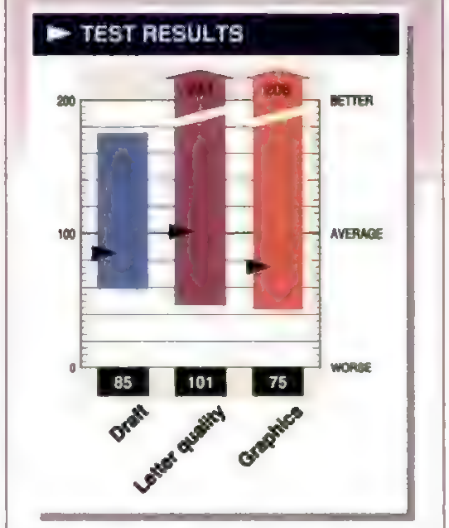
Star Micronics XR-1020 Multi-Font



9-pin scores

In Short: The $549 9-pin narrow-carriage Star Micronics XR-1020 Multi-Font is an unremarkable medium-duty printer.

Star Micronics XR-1520 Multi-Font



9-pin scores

In Short: The $699 9-pin Star Micronics XR-1520 Multi-Font is another medium-duty printer, this time in a wide-carriage format.

TANDY CORP.

Tandy DMP 135
Tandy DMP 136
Tandy DMP 202

by Joseph Desposito

Tandy Corp. is presenting three new dot matrix printers this year and positioning them at lower price points than its entries a year ago. For the 24-pin line, the $399.95 Tandy DMP 202 is priced $100 lower than the older DMP 240, but it sacrifices speed and features. For the 9-pin line (130 series), there are no such tradeoffs. Tandy's $319.95 DMP 135 and $299.95 DMP 136 (both narrow-carriage machines) are priced $40 and $60 lower, respectively, than the soon-to-be-discontinued DMP 134, yet they offer increased speed and more features.

Tandy operates over 7,000 retail stores nationwide, which can mean benefits such as available supplies and repair services at any of its stores. But with Tandy planning to close its Computer Centers, some stores may not stock the whole line of printers. You can order a printer, though, and expect to have it within two days.

Usually, the criteria for review in *PC Magazine*'s special printer issue include the stipluation that printers must be manufactured and distributed by the same company. Although Tandy does not manufacture any of the three printers we reviewed here (they are manufactured to Tandy's specifications by Citizen America), *PC Magazine* is making an exception in this case because of Tandy's wide customer base and distribution network.

A new Tandy dot matrix printer not reviewed here, but scheduled to be available by the time you read this, is the DMP 2104. This is a 24-pin wide-carriage printer that replaces the DMP 442 in the Tandy line. Designed for the small-business market, this printer is similar to the DMP 202 and sells for $599.

THE DMP 202

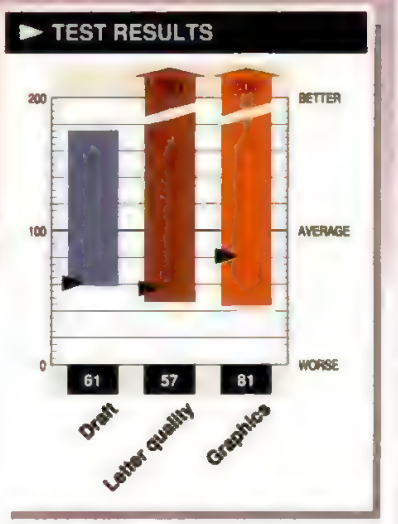
Simplicity is the key feature of Tandy's DMP 202 24-pin printer, a narrow-carriage model that sells for $399.95. Its comparative dearth of features is foreshadowed by its tiny control panel. With only two membrane switches, a user can select letter quality, draft, and super speed draft, as well as the more common form-feed/line-feed and on/off. A green LED signals the appropriate print mode by blinking one, two, or three times.

The DMP 202 is easy to set up. Pop in a ribbon, slip fanfold paper into the tractor-feed mechanism, and pull on the paper bail; the paper loads automatically. Don't worry about emulations: IBM Proprinter is the only one available. Setting DIP switches is a minor annoyance; they are below the ribbon, which forces you to remove the ribbon to get at them.

The DMP 202 has a built-in tractor feed and a plastic paper rack for feeding single sheets of paper. Although the specifications for the printer include paper parking, this feature is not automatic; you must manually retract the fanfold paper from the platen. With the fanfold paper retracted, the printer automatically advances any sheet of paper or envelope you place in the sheet-feed rack.

The narrow-carriage printer handles multipart forms easily, but it has trouble with heavy paper stock, which lifts the paper bail and stops feeding through the printer. The DMP 202 also had some significant printing speed difficulties. On PC Magazine Labs' text speed test, the DMP 202 muddled through 71 characters per second in its IBM Proprinter draft mode. In letter-quality mode, the DMP 202 could muster only 29 cps.

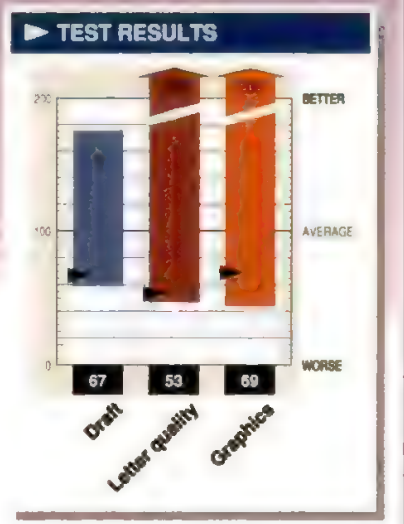
Tandy DMP 135



9-pin scores

In Short: The $319.95 9-pin narrow-carriage Tandy DMP 135 employs a novel way of selecting fonts and pitch size, but it is still merely another low-end printer.

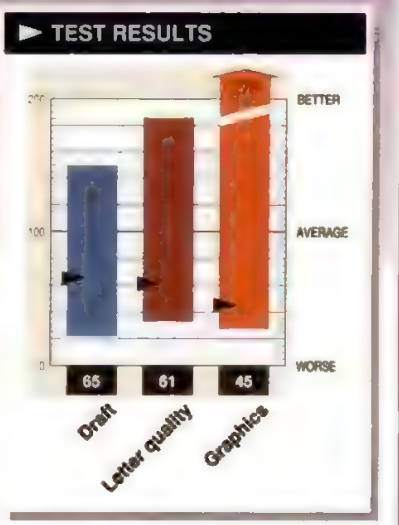
Tandy DMP 136



9-pin scores

In Short: This $299.95 9-pin narrow-carriage unit has many of the features you look for in a low-end printer—color capability, dual paper feed, automatic paper parking, and a tear-off feature—all at a reasonable price.

Tandy DMP 202



24-pin scores

In Short: The $399.95 24-pin narrow-carriage Tandy DMP 202 is simple to operate and produces quality print, but it suffers from a dearth of features.

THE DMP 135

The Tandy DMP 135, a narrow-carriage model that sells for $319.95, is $20 more expensive than the other 9-pin printer in Tandy's line. The DMP 135's most interesting feature is its control panel, which consists of four membrane switches with Right and Left Arrow symbols below the middle two. Pressing these cursor-key switches when the printer is off-line moves the printhead back and forth. You use this technique to select font names, pitch sizes, and other attributes embossed on the clear plastic machine cover. This method is unconventional, but you can easily become accustomed to it. The control panel also lets you perform more-conventional operations, such as parking fanfold paper.

Text options are satisfactory for a 9-pin printer. To switch between Epson FX and IBM Proprinter emulations, you just flip one of the DIP switches conveniently located beneath the front edge of the printer cover. You may select one of four near-letter-quality typefaces: Courier, Gothic, Prestige, and sans serif. None of them, however, are particularly appealing. On PC Magazine Labs' text speed test, the default Courier font printed at a mediocre 32 cps in IBM Proprinter NLQ mode and 99 cps in draft mode.

When using the paper-parking feature, the DMP 135 printed fine on single sheets of paper, but it produced streaky output when printing on envelopes. This printer does not have color capability, but Tandy sells a $19.95 set of single-color ribbons, which at least allows you to print in colors other than black.

THE DMP 136

At $299.95, the narrow-carriage Tandy DMP 136 is the lowest-priced printer in the Tandy line. The DMP 136 is color-capable with the addition of a $29.95 color ribbon and motor. A 9-pin printer, the DMP 136 is very similar in design to the 24-pin DMP 240 (both are manufactured by Citizen) and Citizen's own 200GX, an Editors' Choice winner in last year's printer issue.

The DMP 136 feeds paper through the usual U path or a slot at the printer's bottom. To take advantage of this, you remove the tractor-feed mechanism from its usual push position and install it in a pull position.

The printer has a hinged cover with an embedded paper bail. This sturdy construction allows the DMP 136 to print on heavy paper stock. The cover also acts as a tearing guide and supports a zero-tear-off feature—especially useful for multipart forms, although it is a bit complex to enable. The printer also supports paper parking, and a paper rack allows for single-sheet feeding. The DMP 136 has its parallel port at the right side of the printer. The review unit also included an optional serial port. You can connect two computers to the printer when the serial interface is installed.

The control panel consists of a mechanical slide switch and four push-buttons. As you slide the switch, different attributes appear. You select attributes—which include print modes, fonts, and pitch—via a push button. The DMP 136 emulates the Epson FX and the IBM Proprinter. Changing emulation modes is done via DIP switches located in a compartment at the printer's right side.

The DMP 136 has three NLQ fonts: Courier, sans serif, and Times Roman. None are particularly appealing. On PC Labs' text speed test, the DMP 136 printed its NLQ font in IBM Proprinter mode at a dawdling 30 cps, and its draft mode was 108 cps.

Print quality was satisfactory, but when printing graphics, the black ribbon slightly streaked black areas and printed coarse dots in shaded areas. And graphics printing with the color ribbon created slight smudges of black in the color areas.

All three printers carry a one-year limited warranty. Out of the Tandy trio, the DMP 136 offers the best array of features for the price. Don't overlook this one if you are in the market for a 9-pin color-capable printer. The DMP 202 and DMP 135 have less to recommend them and seem relatively poor in features. ■

FACT FILE

Tandy Corp., 1800 One Tandy Center, Fort Worth, TX 76102; 817-390-3011.

Tandy DMP 135
List Price: $319.95; 32K RAM upgrade, $59.95.
Standard Warranty: One year (limited).
Dimensions (HWD): 5 x 15 x 14 inches.
Weight: 8 lbs.
Emulations: Epson FX, IBM Proprinter.

Tandy DMP 136
List Price: $299.95; color option, $29.95; serial port, $49.95.
Standard Warranty: One year (limited).
Dimensions (HWD): 6 x 17 x 14 inches.
Weight: 11 lbs.
Emulations: Epson FX, IBM Proprinter.

Tandy DMP 202
List Price: $399.95.
Standard Warranty: One year (limited).
Dimensions (HWD): 5 x 16 x 14 inches.
Weight: 9 lbs.
Emulations: IBM Proprinter.

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CIRCLE 521 ON READER SERVICE CARD

INDEX TO PRINTER REVIEWS (1984–1991)

Over the last eight years, PC Magazine Labs has tested more than 800 printers for reviews in eight annual issues. Of those reviewed units, 310 are still available from the manufacturers and are included in this index, along with the 106 printers evaluated in the current issue.

We have listed engine types, current prices (as of September 1, 1991), and speed scores on PC Labs' text speed test. For your reference, we have also provided volume, issue, and page numbers of the original reviews. Where upgrades exist but were not considered significant enough to warrant a review in *PC Magazine*, we have listed the original versions we did review. For printers that have stayed the same while their names have changed, we use the new names.

Since most dot matrix printers are now available with color options, we no longer differentiate between monochrome and color-capable dot matrix printers. The price listed in each case is for the standard printer, without a color option. Because color PostScript printers belong in a category of their own, we have indicated which thermal wax transfer and solid-ink PostScript-compatible printers handle color.

PC Labs' text speed test has remained virtually unchanged since our first printer issue, letting you compare speeds across eight years of products. Page printer speeds are measured in pages per minute (ppm); dot matrix speeds are measured in characters per second (cps); line printers in lines per minute (lpm). While laser print speed is not directly comparable with dot matrix or ink jet speed, a score of 1 page per minute falls roughly within a range of 25 to 30 characters per second for double-spaced text, or 50 to 60 cps single-spaced.

For quick comparisons of output and test results of the printers reviewed in this issue, see the *PC Magazine* Printer Guides.

Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
A								
Advanced Matrix Technology	Accel-500	DM	161 cps	$1,485	8	19	345	
AEG Olympia	**■ NP 136-24**	**DM**	**118 cps**	**$699**	**8**	**19**	**246**	
AEG Olympia	NP 136SE	DM	145 cps	$599	9	19	334	
AEG Olympia	NP 80-24	DM	115 cps	$599	8	19	246	
AEG Olympia	NP 80-24E	DM	105 cps	$499	9	19	334	
AEG Olympia	NP 80SE	DM	126 cps	$499	9	19	334	
AEG Olympia	NPC 136-24	DM	96 cps	$799	8	19	345	
AGFA	P3400 PS	L	10.5 ppm	$6,495	8	19	117	
ALPS	Allegro 500	DM	113 cps	$499	9	19	345	
ALPS	Allegro 500XT	DM	138 cps	$799	9	19	345	
ALPS	ASP1600	DM	59 cps	$299	9	19	339	
Apple	**■ LaserWriter IINT**	**L**	**6.4 ppm**	**$3,999**	**7**	**18**	**116**	
Apple	**■ LaserWriter IINTX**	**L**	**6.8 ppm**	**$4,999**	**7**	**18**	**116**	
Apple	Personal LaserWriter NT	L	3.9 ppm	$2,599	9	19	152	
AT&T	570	DM	124 cps	$695	8	19	250	
AT&T	583	DM	94 cps	$1,295	8	19	348	
Axonix	LiteWrite	DM	50 cps	$529	8	19	326	
Axonix	ThinWrite 100	DM	60 cps	$499	6	19	255	
B								
Bézier	BP4040	L	3.9 ppm	$1,895	10	20	150	420
Brother	HL-4PS	L	3.9 ppm	$2,595	10	20	156	421
Brother	HL-8V	L	7.6 ppm	$2,495	10	20	156	421
Brother	**■ HL-8PS**	**L**	**7.4 ppm**	**$4,495**	**8**	**19**	**120**	
Brother	M-1309	DM	105 cps	$299	10	20	414	396
Brother	M-1324	DM	106 cps	$399	10	20	414	396
Brother	M-1809	DM	83 cps	$549	8	19	350	
Brother	M-1824L	DM	121 cps	$749	8	19	352	
Brother	M-1909	DM	129 cps	$699	9	19	345	
Brother	M-1924L	DM	122 cps	$949	9	19	346	
Brother	M-2518	DM	123 cps	$1,295	7	18	240	
Brother	M-4018	DM	258 cps	$1,795	6	19	260	
Bull	Compuprint 4/22	DM	117 cps	$499	9	19	348	

■—Editors' Choice, C—color, DM—dot matrix, DW—daisy wheel, IJ—ink jet, L—laser, SI—solid ink, TT—thermal transfer.

INDEX TO PRINTER REVIEWS (1984–1991)

Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
Bull	Compuprint 4/23	DM	116 cps	$699	9	19	348	
Bull	Compuprint 4/24	DM	113 cps	$995	9	19	351	
Bull	Compuprint 4/40	DM	154 cps	$1,245	9	19	351	
Bull	Compuprint 4/43	DM	142 cps	$1,995	9	19	352	
Bull	Compuprint 4/66	DM	235 cps	$2,395	6	19	302	
Bull	Compuprint 4/68	DM	192 cps	$2,545	9	19	358	
Bull	Compuprint 970	DM	284 cps	$3,295	10	20	415	397
C								
Calcomp	ColorMaster Plus 6603PS	CTT	0.9 ppm	$6,995	10	20	329	549
Canon	**■ BJ-10e**	**IJ**	**40 cps**	**$499**	**9**	**19**	**276**	
Canon	BJ-130	IJ	68 cps	$1,095	7	18	243	
Canon	**■ BJ-300 Bubble Jet Printer**	**IJ**	**198 cps**	**$799**	**10**	**20**	**366**	**413**
Canon	**■ BJ-330 Bubble Jet Printer**	**IJ**	**198 cps**	**$949**	**10**	**20**	**366**	**413**
Canon	LBP-4	L	3.9 ppm	$1,545	9	19	156	
Canon	LBP-8 Mark III	L	7.3 ppm	$2,495	8	19	124	
Canon	LBP-8 Mark IIIR	L	7.4 ppm	$3,795	9	19	165	
Canon	LBP-8 Mark IIIT	L	7.5 ppm	$3,295	9	19	165	
CIE	C-815	DM	195 cps	$2,295	6	19	268	
CIE	CI-250 LXP	DM	349 lpm	$2,295	10	20	420	398
CIE	CI-500	DM	370 lpm	$5,895	10	20	420	398
CIE	CI-1000	DM	388 cps	$7,895	9	19	364	
CIE	CI-5000	DM	250 cps	$1,995	9	19	358	
Citizen	GSX-130	DM	127 cps	$399	10	20	421	399
Citizen	**■ GSX-140**	**DM**	**94 cps**	**$499**	**9**	**19**	**361**	
Citizen	GSX-140 Plus	DM	112 cps	$499	10	20	421	399
Citizen	GSX-145	DM	100 cps	$649	10	20	421	399
Citizen	HSP-500	DM	151 cps	$499	8	19	357	
Citizen	HSP-550	DM	156 cps	$699	8	19	357	
Citizen	**■ PN48**	**TT**	**24 cps**	**$469**	**10**	**20**	**421**	**399**
Citizen	**■ 200GX**	**DM**	**108 cps**	**$299**	**9**	**19**	**360**	
Citizen	200GX Fifteen	DM	100 cps	$499	10	20	421	399
C-Tech	ProWriter C-240	DM	113 cps	$449	9	19	365	
C-Tech	ProWriter C-245	DM	110 cps	$559	9	19	365	
C-Tech	ProWriter C-310 XP	DM	157 cps	$739	5	19	174	
C-Tech	ProWriter C-315 XP	DM	150 cps	$919	5	19	174	
C-Tech	ProWriter C-510	DM	111 cps	$639	9	19	368	
C-Tech	ProWriter C-515	DM	110 cps	$749	9	19	368	
C-Tech	ProWriter C-610+	DM	113 cps	$799	9	19	368	
C-Tech	ProWriter C-610C+	DM	112 cps	$859	9	19	368	
C-Tech	ProWriter C-645	DM	168 cps	$1,395	9	19	371	
C-Tech	**■ ProWriter C-715A**	**DM**	**145 cps**	**$1,499**	**6**	**19**	**267**	
C-Tech	C.Itoh ProWriter CI-4	L	4 ppm	$1,245	10	20	164	422
D								
Dataproducts	8070 Plus	DM	250 cps	$1,795	7	18	261	
Dataproducts	9030	DM	136 cps	$649	9	19	372	
Dataproducts	9044	DM	104 cps	$1,099	9	19	372	
Dataproducts	LZR 960	L	8.1 ppm	$2,995	10	20	164	423
Datasouth	DS 180	DM	128 cps	$1,395	3	23	223	
Datasouth	DS 220	DM	150 cps	$1,695	3	23	226	
Datasouth	Performax	DM	207 cps	$2,995	10	20	432	400
Datasouth	XL-300	DM	184 cps	$1,599	10	20	432	400
DCS/Fortis	**■ DM2215**	**DM**	**132 cps**	**$529**	**8**	**19**	**268**	
DCS/Fortis	DM3215	DM	125 cps	$699	9	19	391	
DCS/Fortis	DQ4110	DM	100 cps	$499	8	19	270	
DCS/Fortis	DQ4210	DM	122 cps	$589	8	19	273	
DCS/Fortis	DQ4215	DM	100 cps	$899	8	19	364	
Digital Equipment Corp.	DEClaser 1150	L	3.9 ppm	$3,049	10	20	166	424
Digital Equipment Corp.	DEClaser 2100	L	7.5 ppm	$2,649	9	19	232	
Digital Equipment Corp.	DEClaser 2150	L	7.4 ppm	$3,499	10	20	166	424
Digital Equipment Corp.	DEClaser 2200	L	7.6 ppm	$3,999	9	19	232	
Digital Equipment Corp.	DEClaser 2250	L	7.4 ppm	$5,149	10	20	166	424

■—Editors' Choice, C—color, DM—dot matrix, DW—daisy wheel, IJ—ink jet, L—laser, SI—solid ink, TT—thermal transfer.

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Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
Digital Equipment Corp.	LA 75 Companion Printer	DM	142 cps	$835	9	19	377	
Digital Equipment Corp.	LA 210	DM	138 cps	$1,675	3	23	213	
Digital Equipment Corp.	LA 324 MultiPrinter	DM	162 cps	$1,995	9	19	377	
Digital Equipment Corp.	LJ252 Companion Color Printer	IJ	62 cps	$1,549	9	19	276	
Digital Equipment Corp.	LN03R-AA	L	7.4 ppm	$3,000	5	19	276	
E								
Eastman Kodak	■ **Diconix 150 Plus**	**IJ**	**70 cps**	**$519**	**8**	**19**	**327**	
Eastman Kodak	Diconix Color 4 Printer	IJ	64 cps	$1,495	10	20	374	414
Eastman Kodak	Ektaplus 7008	L	7.4 ppm	$1,395	10	20	177	425
Eastman Kodak	Ektaplus 7016 PS	L	14.7 ppm	$5,795	10	20	276	618
Eicon Technology	EiconLaser	L	7.3 ppm	$5,595	10	20	180	426
Epson	DFX-5000	DM	307 cps	$2,199	7	18	267	
Epson	■ **DFX-8000**	**DM**	**264 cps**	**$3,699**	**9**	**19**	**380**	
Epson	EPL-7000	L	5.7 ppm	$1,399	10	20	181	427
Epson	EPL-7500	L	5.9 ppm	$2,999	10	20	181	427
Epson	FX-850	DM	138 cps	$499	7	18	267	
Epson	■ **FX-1050**	**DM**	**141 cps**	**$699**	**8**	**19**	**260**	
Epson	■ **LQ-1170**	**DM**	**140 cps**	**$1,049**	**10**	**20**	**441**	**401**
Epson	LQ-200	DM	89 cps	$399	10	20	441	401
Epson	LQ-2550	DM	105 cps	$1,499	8	19	362	
Epson	■ **LQ-570**	**DM**	**103 cps**	**$499**	**10**	**20**	**441**	**401**
Epson	LQ-860	DM	128 cps	$949	9	19	383	
Epson	■ **LQ-870**	**DM**	**141 cps**	**$749**	**10**	**20**	**441**	**401**
Epson	■ **LX-810**	**DM**	**94 cps**	**$269**	**8**	**19**	**266**	
Everex Systems	LaserScript LX	L	6 ppm	$1,995	10	20	187	428
F								
Facit	B1200	DM	74 cps	$289	9	19	384	
Facit	B2400	DM	111 cps	$699	8	19	266	
Facit	B3100	DM	149 cps	$749	6	19	284	
Facit	B3450	DM	134 cps	$1,349	9	19	386	
Facit	B3550C	DM	181 cps	$1,499	8	19	363	
Facit	P6060	L	5.7 ppm	$1,599	9	19	180	
Fujitsu	DL3400	DM	143 cps	$699	6	19	291	
Fujitsu	DL3600	DM	154 cps	$949	10	20	444	402
Fujitsu	DL4600	DM	169 cps	$1,199	9	19	392	
Fujitsu	DL5600	DM	230 cps	$2,195	7	18	276	
Fujitsu	RX7300E	L	14.8 ppm	$7,150	8	19	146	
G								
GCC Technologies	BLP II	L	4.2 ppm	$1,999	10	20	191	429
GCC Technologies	BLP IIS	L	7.9 ppm	$2,899	10	20	191	429
General Parametrics	Spectra*Star 430	CTT	0.8 ppm	$6,995	10	20	336	550
Genicom	1020	DM	111 cps	$1,218	5	19	194	
Genicom	1040	DM	103 cps	$1,799	8	19	368	
Genicom	3320 Quiet	DM	144 cps	$2,044	4	19	166	
Genicom	3410XLQ	DM	150 cps	$2,262	8	19	273	
Genicom	■ **3840E**	**DM**	**212 cps**	**$2,595**	**10**	**20**	**445**	**403**
H								
Hewlett-Packard	■ **DeskJet 500**	**IJ**	**62 cps**	**$729**	**9**	**19**	**290**	
Hewlett-Packard	■ **LaserJet IIP**	**L**	**3.9 ppm**	**$1,295**	**8**	**19**	**152**	
Hewlett-Packard	■ **LaserJet III**	**L**	**7.5 ppm**	**$2,395**	**9**	**19**	**184**	
Hewlett-Packard	■ **LaserJet IIID**	**L**	**7.6 ppm**	**$3,595**	**9**	**19**	**184**	
Hewlett-Packard	■ **LaserJet IIIP**	**L**	**4 ppm**	**$1,595**	**10**	**20**	**192**	**542**
Hewlett-Packard	■ **LaserJet IIISi**	**L**	**14.6 ppm**	**$5,495**	**10**	**20**	**289**	**619**
Hewlett-Packard	PaintJet	IJ	78 cps	$995	6	19	297	
Hewlett-Packard	PaintJet XL	IJ	65 cps	$2,495	9	19	290	
Hewlett-Packard	RuggedWriter	DM	173 cps	$1,895	7	18	280	
Hewlett-Packard	ThinkJet	IJ	70 cps	$595	3	23	172	

■—Editors' Choice, C—color, DM—dot matrix, DW—daisy wheel, IJ—ink jet, L—laser, SI—solid ink, TT—thermal transfer.

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Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
I								
IBM/Lexmark	■ **ExecJet Printer**	IJ	**198 cps**	**$1,099**	**10**	**20**	**378**	**415**
IBM/Lexmark	■ **LaserPrinter**	L	**8.9 ppm**	**$2,395**	**8**	**19**	**156**	
IBM/Lexmark	LaserPrinter 5e	L	4.5 ppm	$1,595	10	20	194	543
IBM/Lexmark	LaserPrinter 6	L	5.7 ppm	$1,895	10	20	194	543
IBM/Lexmark	■ **LaserPrinter 10**	L	**9.1 ppm**	**$2,395**	**10**	**20**	**194**	**543**
IBM/Lexmark	LaserPrinter 10L	L	8.9 ppm	$2,995	10	20	292	620
IBM/Lexmark	■ **LaserPrinter E**	L	**4.8 ppm**	**$1,495**	**9**	**19**	**190**	
IBM/Lexmark	Personal Printer Series II 2380	DM	153 cps	$499	10	20	448	404
IBM/Lexmark	Personal Printer Series II 2381	DM	162 cps	$699	10	20	448	404
IBM/Lexmark	Personal Printer Series II 2390	DM	112 cps	$499	10	20	448	404
IBM/Lexmark	Personal Printer Series II 2391	DM	120 cps	$699	10	20	448	404
IBM/Lexmark	Proprinter X24E	DM	100 cps	$859	8	19	286	
IBM/Lexmark	■ **Proprinter XL24E**	DM	**159 cps**	**$1,099**	**8**	**19**	**286**	
IBM/Lexmark	Proprinter 24P	DM	102 cps	$499	10	20	448	404
IBM/Lexmark	■ **4226 Printer**	DM	**229 cps**	**$2,295**	**10**	**20**	**448**	**404**
K								
Kyocera	F-1000A	L	9.4 ppm	$2,895	7	18	152	
Kyocera	F-1800A	L	15.2 ppm	$4,995	9	19	195	
Kyocera	F-2010	L	6.8 ppm	$4,295	6	19	188	
Kyocera	F-5000A	L	13.6 ppm	$7,995	10	20	297	621
L								
Laser Computer	Laser 190E	DM	90 cps	$219	8	19	288	
LaserMaster	LM 1000	L	N/A	$6,995	9	19	211	
LaserMaster	TrueTech 800/4	L	3.7 ppm	$3,695	10	20	203	544
LaserMaster	TrueTech 1000	L	7.2 ppm	$6,995	10	20	203	544
LaserMaster	TrueTech 1200	L	14.9 ppm	$14,995	10	20	307	622
LaserMaster	WinPrinter 400	L	4 ppm	$1,195	10	20	204	614
M								
Mannesmann Tally	■ **MT661**	DM	**674 lpm**	**$6,999**	**10**	**20**	**455**	**405**
Mannesmann Tally	MT735	TT	6.3 ppm	$1,295	10	20	206	545
Mannesmann Tally	MT82	DM	73 cps	$499	10	20	455	405
Mannesmann Tally	MT911 PS	L	9 ppm	$3,195	10	20	206	545
Mannesmann Tally	130/9	DM	131 cps	$699	9	19	401	
Mannesmann Tally	130/24	DM	128 cps	$899	9	19	402	
Mannesmann Tally	131/9	DM	120 cps	$799	9	19	401	
Mannesmann Tally	131/24	DM	127 cps	$999	9	19	402	
Mannesmann Tally	230/24	DM	108 cps	$1,799	7	18	291	
Mannesmann Tally	290	DM	133 cps	$1,399	5	19	208	
Mannesmann Tally	330	DM	190 cps	$2,349	6	19	320	
Mannesmann Tally	340	DM	150 cps	$2,449	7	18	292	
Mannesmann Tally	■ **490**	DM	**247 cps**	**$3,779**	**5**	**19**	**250**	
Mannesmann Tally	645	DM	313 cps	$5,999	9	19	342	
Mannesmann Tally	81	DM	73 cps	$259	8	19	298	
Mannesmann Tally	87	DM	113 cps	$599	6	19	317	
Mannesmann Tally	906 PS	L	5.8 ppm	$2,795	9	19	196	
Microtek Lab	TrueLaser	L	6.1 ppm	$2,695	10	20	227	546
Mitek Systems	130TE	L	7.5 ppm	$8,995	9	19	199	
N								
NCR	6417-0101	DM	162 cps	$600	9	19	406	
NCR	6421-0201	DM	134 cps	$1,050	9	19	407	
NCR	6436-0301	L	12.4 ppm	$7,995	10	20	308	623
NEC	Colormate PS Model 40	CTT	1.8 ppm	$6,995	10	20	338	601
NEC	Pinwriter P3200	DM	104 cps	$429	10	20	456	406
NEC	Pinwriter P3300	DM	102 cps	$599	10	20	456	406
NEC	■ **Pinwriter P6200**	DM	**144 cps**	**$749**	**9**	**19**	**407**	
NEC	■ **Pinwriter P6300**	DM	**146 cps**	**$999**	**9**	**19**	**407**	
NEC	Pinwriter P9300	DM	162 cps	$1,395	10	20	456	406
NEC	Silentwriter LC 890XL	L	7.4 ppm	$5,995	8	19	164	

■—Editors' Choice, C—color, DM—dot matrix, DW—daisy wheel, IJ—ink jet, L—laser, SI—solid ink, TT—thermal transfer.
N/A—Not applicable: The product was not able to perform our text speed test.

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NEC	■ **Silentwriter2 90**	**L**	**5.8 ppm**	**$2,495**	**9**	**19**	**205**	
NEC	Silentwriter2 990	L	7.5 ppm	$4,495	10	20	229	547
NewGen Systems	TurboPS/360	L	2.1 ppm	$4,995	9	19	220	
NewGen Systems	TurboPS/480	L	2.1 ppm	$7,495	9	19	220	
O								
Océ Graphics	G5241-PS	CTT	1.2 ppm	$8,990	10	20	343	602
Office Automation Systems	LaserPro 1510	L	13.5 ppm	$6,350	7	18	156	
Office Automation Systems	LaserPro 810	L	7.5 ppm	$3,495	5	19	292	
Okidata	Microline 172	DM	83 cps	$289	8	19	299	
Okidata	Microline 182 Turbo	DM	95 cps	$339	8	19	300	
Okidata	■ **Microline 320**	**DM**	**164 cps**	**$499**	**7**	**18**	**300**	
Okidata	■ **Microline 321**	**DM**	**157 cps**	**$699**	**7**	**18**	**300**	
Okidata	Microline 380	DM	89 cps	$349	9	19	414	
Okidata	Microline 390 Plus	DM	140 cps	$699	9	19	419	
Okidata	Microline 391 Plus	DM	140 cps	$949	9	19	419	
Okidata	Microline 393 Plus	DM	167 cps	$1,499	9	19	420	
Okidata	Microline 393C	DM	163 cps	$1,599	7	18	302	
Okidata	OL400	L	4.1 ppm	$999	9	19	224	
Okidata	OL820	L	8.1 ppm	$1,999	9	19	226	
Okidata	■ **OL830**	**L**	**8.1 ppm**	**$1,999**	**10**	**20**	**232**	**548**
Okidata	OL840	L	7.7 ppm	$2,599	9	19	227	
Okidata	■ **Pacemark 2410**	**DM**	**216 cps**	**$2,599**	**4**	**19**	**168**	
Output Technology Corp.	560DL	DM	147 cps	$1,995	8	19	301	
Output Technology Corp.	DuraLine	DM	217 cps	$2,995	10	20	465	407
Output Technology Corp.	TriMatrix 850XL	DM	307 cps	$2,495	6	19	330	
P								
Panasonic	KX-P1123	DM	92 cps	$369.95	10	20	466	408
Panasonic	KX-P1124i	DM	107 cps	$500	10	20	466	408
Panasonic	■ **KX-P1180**	**DM**	**59 cps**	**$270**	**8**	**19**	**303**	
Panasonic	KX-P1624	DM	96 cps	$600	9	19	428	
Panasonic	KX-P1695	DM	140 cps	$630	9	19	428	
Panasonic	■ **KX-P2624**	**DM**	**111 cps**	**$700**	**10**	**20**	**466**	**408**
Panasonic	KX-P4420 Laser Partner	L	7.4 ppm	$1,395	9	19	235	
Panasonic	KX-P4450i Laser Partner	L	10.2 ppm	$2,099	9	19	236	
Panasonic	KX-P4455 Laser Partner	L	10.2 ppm	$2,995	10	20	236	612
Primages	Primage 90-GT	DW	56 cps	$1,500	6	19	386	
Printek	FormsPro 2000	DM	111 cps	$2,095	5	19	247	
Printronix	L2324 Page Printer	L	20.9 ppm	$14,495	8	19	167	
Printronix	P3240	DM	290 lpm	$6,345	10	20	470	409
Printware	720 IQ Professional-II	L	7.5 ppm	$13,990	9	19	240	
Printware	Printware Pro-III	L	8.5 ppm	$17,990	10	20	311	624
Q								
QMS	■ **ColorScript 100 Model 10**	**CTT**	**2.8 ppm**	**$8,995**	**8**	**19**	**217**	
QMS	ColorScript 100 Model 10p	CTT	1.2 ppm	$6,995	10	20	347	603
QMS	PS-410	L	3.6 ppm	$2,795	9	19	251	
QMS	PS-810	L	6.7 ppm	$3,995	7	18	165	
QMS	PS-810 Turbo	L	7.5 ppm	$5,495	9	19	252	
QMS	PS-815	L	7.5 ppm	$4,995	10	20	240	613
QMS	PS-815 MR	L	7.3 ppm	$5,495	10	20	240	613
QMS	PS-820	L	6.9 ppm	$4,995	8	19	172	
QMS	PS-820 Turbo	L	7.5 ppm	$6,495	9	19	252	
QMS	PS-825	L	7.4 ppm	$5,995	10	20	240	613
QMS	PS-1500	L	8.8 ppm	$7,995	8	19	174	
QMS	■ **PS-2000**	**L**	**17.2 ppm**	**$15,995**	**10**	**20**	**314**	**625**
QMS	■ **PS-2210**	**L**	**17.3 ppm**	**$9,995**	**9**	**19**	**256**	
Qume	CrystalPrint Express	L	2.6 ppm	$5,595	9	19	242	
Qume	CrystalPrint Publisher	L	5.1 ppm	$3,499	8	19	176	
Qume	CrystalPrint Publisher II	L	5.2 ppm	$3,795	9	19	245	
Qume	CrystalPrint Series II	L	6.5 ppm	$1,499	9	19	245	
Qume	CrystalPrint Super Series II	L	6 ppm	$1,999	9	19	246	
Qume	Sprint 11/55 Plus	DW	54 cps	$1,295	3	23	340	

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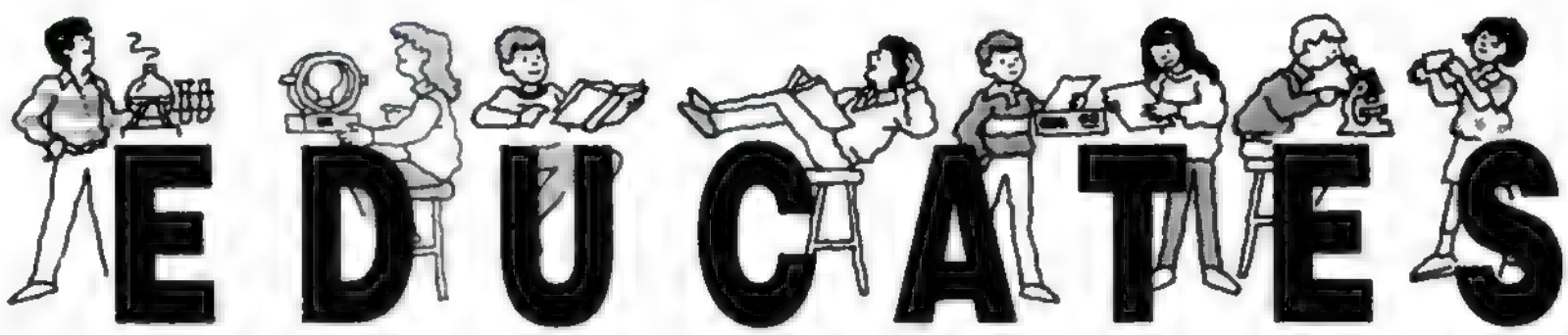
S								
Seiko	ColorPoint PSX Model 4	CTT	0.9 ppm	$9,499	10	20	352	604
Seiko	ColorPoint PSX Model 14	CTT	0.6 ppm	$12,999	10	20	352	604
Seikosha	BP 5460	DM	238 cps	$1,999	8	19	307	
Seikosha	BP 5780	DM	221 cps	$2,200	10	20	471	410
Seikosha	LT 20	DM	23 cps	$499	10	20	471	410
Seikosha	SBP-10AI	DM	314 cps	$4,495	7	18	309	
Seikosha	SK-3005AI	DM	170 cps	$849	6	19	349	
Seikosha	SL-90	DM	63 cps	$499	9	19	429	
Seikosha	SL-230AI	DM	77 cps	$1,999	8	19	307	
Seikosha	SP-2000	DM	86 cps	$329	9	19	429	
Sharp	JX-9500H	L	8.5 ppm	$1,599	10	20	252	615
Sharp	JX-9500PS	L	6.5 ppm	$2,849	10	20	252	615
Sharp	JX-9700	L	14.4 ppm	$3,395	10	20	317	626
Siemens Nixdorf	Ink Jet PT 88S-32	IJ	97 cps	$718	8	19	312	
Siemens Nixdorf	Ink Jet PT 90-12	IJ	136 cps	$1,500	8	19	309	
Star Micronics	StarJet SJ-48	IJ	38 cps	$499	10	20	378	416
Star Micronics	LaserPrinter 4	L	4 ppm	$1,395	10	20	254	616
Star Micronics	LaserPrinter 4 StarScript	L	4 ppm	$1,995	10	20	254	616
Star Micronics	NX-1001 Multi-Font	DM	97 cps	$229	10	20	472	411
Star Micronics	NX-1020 Rainbow	DM	96 cps	$299	10	20	472	411
Star Micronics	NX-1500 Multi-Font	DM	91 cps	$499	9	19	430	
Star Micronics	NX-2410 Multi-Font	DM	91 cps	$399	9	19	436	
Star Micronics	NX-2415 Multi-Font	DM	100 cps	$559	9	19	436	
Star Micronics	NX-2420 Multi-Font	DM	94 cps	$449	10	20	472	411
Star Micronics	NX-2420 Rainbow	DM	90 cps	$499	10	20	472	411
Star Micronics	XB-2410 Multi-Font	DM	117 cps	$699	8	19	313	
Star Micronics	■ **XB-2415 Multi-Font**	**DM**	**110 cps**	**$899**	**8**	**19**	**374**	
Star Micronics	XB-2420 Multi-Font	DM	136 cps	$749	10	20	472	411
Star Micronics	XB-2425 Multi-Font	DM	135 cps	$949	10	20	472	411
Star Micronics	XR-1020 Multi-Font	DM	137 cps	$549	10	20	472	411
Star Micronics	XR-1500 Multi-Font	DM	127 cps	$749	8	19	313	
Star Micronics	XR-1520 Multi-Font	DM	137 cps	$699	10	20	472	411
T								
Talaris	1590-T Printstation	L	11 ppm	$8,990	8	19	187	
Tandy	DMP 135	DM	99 cps	$320	10	20	478	412
Tandy	DMP 136	DM	108 cps	$300	10	20	478	412
Tandy	DMP 202	DM	71 cps	$400	10	20	478	412
Tandy	DMP 240	DM	98 cps	$450	9	19	441	
Tandy	DMP 300	DM	132 cps	$599	8	19	316	
Tandy	DMP 2102	DM	136 cps	$899	8	19	318	
Tandy	DMP 2130	DM	108 cps	$1,199	9	19	438	
Tandy	LP 950	L	6.2 ppm	$1,599	10	20	256	617
Tektronix	Phaser II PXi	CTT	1.2 ppm	$7,995	10	20	357	605
Tektronix	■ **Phaser III PXi**	**CSI**	**0.5 ppm**	**$9,995**	**10**	**20**	**357**	**605**
Texas Instruments	880 AT	DM	172 cps	$2,195	5	19	252	
Texas Instruments	885	DM	195 cps	$2,295	6	19	365	
Texas Instruments	8930	DM	174 cps	$2,545	9	19	441	
Texas Instruments	microLaser	L	6.3 ppm	$999	9	19	258	
Texas Instruments	microLaser XL PS35	L	14.7 ppm	$3,149	10	20	320	627
Texas Instruments	OmniLaser 2015	L	7.1 ppm	$5,995	5	19	296	
Texas Instruments	OmniLaser 2115	L	9.5 ppm	$7,995	6	19	234	
U								
Unisys	■ **AP 1324**	**DM**	**117 cps**	**$1,695**	**8**	**19**	**319**	
Unisys	AP 9215-1	L	13.4 ppm	$5,995	8	19	190	
Unisys	AP 9230	L	21.5 ppm	$16,750	8	19	195	
V								
Varityper	■ **VT600P**	**L**	**7.9 ppm**	**$11,995**	**8**	**19**	**197**	
X								
Xerox	4045 Laser CP Model 160	L	9.2 ppm	$5,000	5	19	294	

■—Editors' Choice, C—color, DM—dot matrix, DW—daisy wheel, IJ—ink jet, L—laser, SI—solid ink, TT—thermal transfer.

INVENTORY



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PC MAGAZINE

by
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Lab Notes

Does Your PC–Or How You Use It–Cause Health Problems?

■ PCs are blamed for a myriad of health problems. But are they really the culprits? This Lab Notes puts these issues in perspective and suggests precautions you can take to stay healthy.

Don't scoff at the joke about catching a virus from your PC. While you have nothing to fear from aberrant bytes in your PC's memory, your computer could be subtly making you sick. Every time you roll your chair up to a PC and lay your fingers on a keyboard, you're risking your health. Working with your PC the way the vast majority of people do today, you can cause yourself a variety of problems ranging from a simple headache to lifetime disability. Software won't save you, nor will any vaccine. But you can save yourself from discomfort and pain by taking some simple precautions.

First, a reality check. Don't be scared by the advertisements warning of dangers to the unborn. No one has convincingly proven a causal relationship between personal computer use and miscarriages, stillbirths, and birth defects. Most research indicates that if there is any danger to fetuses or pregnant women, the cause is probably not anything the equipment does to the user but what users do to themselves.

The supposed dangers of monitor radiation have alerted people to the potential dangers of working on electronic equipment. While the question of whether PC radiation can damage your health remains unresolved, a number of other health-related issues have been definitively settled.

ENVIRONMENTAL ISSUES

Most PC-related health problems are attributable to a poor office environment. In most cases, your workplace is what your employer provides for you; if you're self-employed or use your PC just for leisure and personal pursuits, you have only yourself to blame.

The issue of a good working environment is particularly important when you work at a PC, because PC users tend to spend more time at their desks, which exacerbates the basic problems, and because the equipment affects what you do and how you feel. Office equipment—not just PCs, but desks and chairs as well—that's badly matched to your body and its needs will inevitably cause you to suffer. You may not feel the effects immediately, but the cumulative effects of years spent working at the PC can literally cripple you.

Most experts agree that three points of contact are the chief concerns in maintaining a healthful workplace: where your eye meets the monitor screen, where your fingers press against the keyboard, and where your body rests in its chair.

THE EYES HAVE IT

There is a general consensus today that staring at a monitor screen all day long does not cause permanent damage in and of itself. This research-based conclusion contradicts earlier speculation that long-term computer use caused such vision problems as myopia (nearsightedness) and cataracts.

The research has been extensive and convincing. For example, studies conducted over a number of years in Canada (5 years) and Holland (2.5 years) found no deterioration in vision from computer use that could not be attributed to normal aging. A report on ophthalmological examinations comparing VDT users and nonusers among members of the Newspaper Guild in 1985 found but one difference between the two groups, a tendency of VDT users to become slightly cross-eyed (esophoric). Admittedly, severe esophoria can be a problem, but the likely cause again was how the VDTs were used, not an intrinsic property of the equipment. In fact, a statement made on behalf of the American Academy of Ophthalmology in 1984 concluded that existing evidence indicated that VDTs were safe for normal use and presented no hazard to vision. There was no indication that VDT use could harm normal eyes or worsen existing pathologic eye conditions.

Monitors do not, however, get a clean bill of health. Over the short term, visual problems do arise among VDT users. In a 1988 study, 26.3 percent of the participants developed significant temporary myopia (nearsightedness) after VDT work, and another 42.1 percent showed changes bordering on significant. A 1984 study showed that after working on a VDT, the time required to shift focus between near and far objects increased. And a 1981 study showed an increased incidence of eye fatigue and irritation among VDT users compared with other office workers, although eye examinations showed the same level of eye problems in both groups. The eye irritation found in this study often persisted well beyond the period in which the VDT was used, often through the next morning.

Scientists have sought the cause of these irritations, and most research points

TYPICAL LUX LEVELS AND RECOMMENDATIONS FOR WORK ENVIRONMENTS

Light level in lux	Environment
100,000	Bright sunlight
30,000	Overcast day
2,500 to 5,000	Recommendation for intricate assembly work
1,500 to 2,000	Brightness created by 100-watt incandescent bulb at a distance of 1 meter (about 3 feet)
1,000 to 2,000	Recommendation for fine work such as precision tuning, fine molding, polishing
750 to 1,500	Recommendation for drafting rooms
400 to 800	Recommendation for general office work
400 to 600	Brightness created by 40-watt incandescent bulb at a distance of 1 meter (about 3 feet) or that of a 100-watt bulb about 6 feet away
100 to 150	Brightness created by 40-watt incandescent bulb at a distance of 2 meters (about 6 feet)
75 to 150	Recommendation for areas not in constant use, such as warehouses, stairwells and corridors
0.1	Full moonlight

Source: *IBM Ergonomics Handbook.*

Figure 1: *Lux* is an international unit of illumination equal to 1 lumen over a 1-meter area. Most office work is done using lighting that's in the 100 to 500 lux range, although 400 to 800 is recommeded. VDT users often prefer less lighting for better screen contrast.

in one direction: not to the VDTs themselves but to how, where, and under what conditions the computer equipment was used. For example, a 1988 study reported in the *New York State Journal of Medicine* attributed the VDT workers' eye irritations to ergonomic considerations such as glare, improper lighting, improperly corrected vision, and poor arrangement of work materials. A Swedish study in 1986 found that glare was significantly correlated with eye fatigue (as was the need to decipher written handwriting).

Eliminating eyestrain, irritation, and fatigue means removing the source of the problems. That means changing the lighting to reduce glare and equalize the illumination on your work, moving your monitor to a more comfortable viewing position to lighten the burden on the muscles that shift your gaze, and, if all else fails, adding a glare shield or even buying a new monitor.

Lighting is an important issue with any work you do. According to most experts, the amount of lighting required varies with the job you're doing. If you're working on watches or doing other delicate, detailed work, you'll want your workplace as bright as 3,500 to 5,000 *lux*. (Lux is a unit of measurement of illumination; bright sunlight is 100,000 lux; a moonlit night, 0.1 lux.) Normal office work falls into the 100 to 500 lux range. In general, VDT users prefer lighting that's on the dark side to offer better screen contrast. On the other hand, dealing with paper work requires brighter light. You'll need to find a happy medium. In most cases, that means reduced overall lighting with a task light, an adjustable lamp that can be focused on your reading materials but not on your monitor screen. The table in Figure 1 lists some typical lux levels and gives recommendations for the level you should use in your work environment.

The worst culprit when it comes to illumination is glare, reflections of bright light off the glass surface of your monitor screen. To reduce glare, many sources recommend diffuse overhead lighting supplemented by localized task lights. If you have a window in your workplace, you should align your monitor screen at right angles to it to minimize glare.

Substantial debate surrounds the issue of antiglare treatments on monitor screens. The treatments decrease contrast and soften the image, putting it slightly out of focus. Of course, antiglare treatment would not be necessary if the monitor were used under optimum viewing conditions. Because few displays are used in optimum conditions, most monitor makers install glare-reducing picture tubes.

Many equipment makers recommend against using an add-on antiglare screen in front of your monitor unless you have no other means of reducing glare. All such screens reduce image sharpness, and that in itself can be a source of fatigue.

In fact, fatigue is one area in which computer equipment itself may be an issue. Some studies have correlated poor-quality displays with increased eye fatigue. A better-quality monitor may be better for you.

If you decide to replace your monitor, consider one with a flatter screen, which is less prone to glare. Curved monitor screens act like the convex mirrors stores use to catch shoplifters: The face of the tube reflects light sources over a wide angle, invariably catching a lamp, overhead light, or window. A flat or nearly-flat screen is less likely to pick up extraneous light sources.

To help you make adjustments to reduce glare, your monitor should be equipped with a tilt-swivel stand. Most health and safety recommendations mandate a tilt-swivel base. The obvious adjustment is to align your monitor to minimize glare. If glare is not a problem, IBM recommends that you align the face of the monitor so that the top of the screen is tilted back 10 to 15 degrees from the vertical.

Another step you can take to combat eye fatigue is to sharpen up your screen by clearing away dust. Monitor screens naturally attract dust because the high voltage used by their electron beams builds up a static charge on the face of the tube. This charge collects dust the same way balloons stick to a wool sweater. Most sources recommend using a damp rag to gently wipe the dust off the screen. Be careful not to get the screen really wet, as any liquid that runs down its face can drip inside and damage the monitor's circuitry.

Research indicates that your eyes will become less fatigued if you don't have to look up at your monitor. Consequently, most experts agree that the optimum height for your monitor screen is such that the top of the screen is at eye level. If you slouch in your chair (which may not be

such a bad posture after all—read on), you may not want to stack your monitor atop your system unit.

You'll also want some kind of stand or holder for your reference material when you type. To minimize eye fatigue, experts recommend that you keep drafts, notes, or whatever you're typing from at the same distance from your eyes as the monitor screen so you don't have to shift focus every time you check your notes. Less shifting of focus is believed to minimize fatigue.

Periodically, however, you should take a break and shift your focus. Look around the office or out the window, count the holes in the acoustical tile—anything to change your focus and relax your eyes. To minimize eye strain, fatigue, and irritation, the idea is to moderate your eye work—don't shift your focus dozens of times a minute, and don't lock your eyes at a consistent distance for hours on end.

A number of studies have shown that the people most likely to suffer from vision-related problems when working on PCs are those who have uncorrected vision deficiencies. While you might be able to read your monitor screen even if you are slightly nearsighted or astigmatic and refuse to wear glasses or contacts, you're more likely to develop headaches and other symptoms of eye strain and fatigue from your work. In addition, some bifocals are not suited to computer work because their change in correction occurs too low.

You should have your eyes checked periodically (some sources say twice a year) if you work regularly on a PC or VDT. In some cases, you might want special corrective lenses to use only while working on your PC. Be sure to let your optometrist or ophthalmologist know that you spend many hours working on a PC.

AT YOUR FINGERTIPS

The hand-to-keyboard relationship is the most strained interface between you and your PC. Typing can be more than just a bothersome task: It can cause permanent damage to your hands and wrists. A study conducted by the South Australian Health Commission in 1984 found that 56 percent of keyboard operators had recurring symptoms of keyboard-caused injury, 8 percent of them so serious they had to contact a health-care provider.

The most serious health problem associated with keyboard use is the same ailment suffered by chicken pluckers and meat packers. The formal name for the ailment is *repetitive strain injury* (RSI). The name explains the cause: Straining to perform the same hand movements over and over again eventually leads to physical damage. With keyboarding, the most common manifestation of RSI is carpal tunnel syndrome. A similar ailment, wrist tendonitis, has also been associated with keyboard use.

The carpal tunnel is a narrow passageway in your wrist through which the median nerve passes; it carries sensations for your entire hand. It also affects the finger flexor tendons, which link your fingers to the muscles in your lower arm. The tunnel is formed by walls of solid bone on three sides with the bottom enclosed by transverse carpal ligament, a tough, inelastic cartilage.

Carpal tunnel syndrome occurs when the tendons protect themselves from overuse. Each tendon is surrounded by a thin, fluid-filled sack called a synovial sheath, which swells with extra fluid to protect the tendon. Scientifically, this swelling is called tendonitis. When these sacks swell in the carpal tunnel, they can pinch the median nerve against the bones or the carpal ligament. The result can be loss of sensation in the hand and debilitating pain.

The prognosis is not good. Treatment may involve an enforced vacation or medical leave of absence during which no typing is permitted. Physical therapy, cortisone injections, and even surgery are sometimes recommended.

Although the problem develops over a period of years, the onset of pain caused by carpal tunnel syndrome often appears suddenly. Some sufferers have no symptoms one night and wake up the next morning in excruciating pain, unable to work, possibly for months. In most cases, those afflicted with carpal tunnel syndrome have ignored all the warning signs: a minor pain in the wrist after a day of typing, some numbness in the thumb or fingers.

People have been typing for over one hundred years, yet carpal tunnel syndrome appears to be a recent phenomenon. The diagnosis is not new, and the condition is not caused by a recently evolved virus or bacterium. People's typing habits have actually changed.

Today, a typist's fingers stay as close to the home row on the keyboard as possible. A simple press of the pinkie is all that's needed to issue a carriage return. Old typewriters required a definite change of position and a resounding right hook to send the carriage back to the left after each page, and at the end of a page the typist had to extract one sheet and roll a new one into the typewriter. All of these simple, necessary acts added variation to the typing process. Moreover, computers encourage extended use, resulting in hour upon hour of entering and editing text and data.

These differences between classic typing and modern keyboarding hint at one

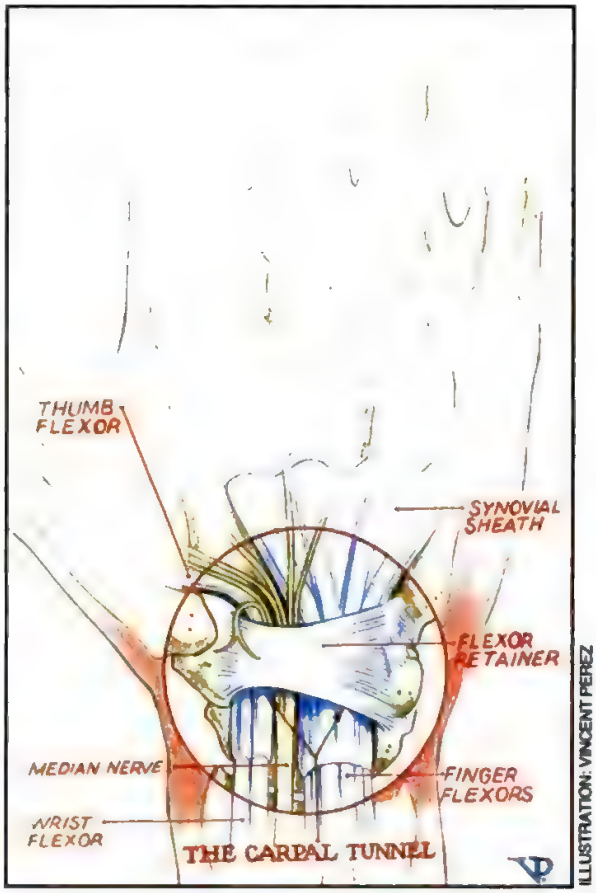

Figure 2: The carpal tunnel is the conduit in the wrist through which both tendons and nerves travel to the hand and fingers. Repetitive motion injuries can cause the tendons to swell, pinching the nerves in the tight tunnel, potentially resulting in pain and paralysis.

way of avoiding carpal tunnel syndrome: Take a break. Remove your fingers from the home row and wrap them around a coffee cup. Do something different for a while. As you'll see in the next section, it's better still to get up from your chair and take a walk or otherwise remove yourself from your workplace.

Sources agree that keyboarding with your wrists in the wrong position aggravates and may cause carpal tunnel syndrome. The wrong position is anything but the naturally straight position your wrists take on in relation to your arm when you stand relaxed with your arms dangling at your side. You should adjust the angle of your keyboard to keep your wrists straight (if you can).

A number of innovative and odd computer keyboard redesigns have been developed by ambitious inventors, most based on sound theory and an overly optimistic view of reality. No matter how beneficial, it's unlikely that bent, oddly shaped, or vertical keyboards will catch on. But keyboards with widened wristrests and add-on accessories that provide wrist support may help keep your hands in the proper typing position.

YOUR ACHING BACK

People whose jobs involve sitting in one place all day long often complain of health problems, from hemorrhoids to obesity to back pain. Putting a PC in front of you won't change those complaints or even cause new ones.

The human body was not designed for the couch potato lifestyle. Proper circulation depends on moving your legs to push venous blood back to your heart. Immobilize yourself in front of a PC and you'll pay for it with aches, pains, and worse. Studies have shown that when office workers spend the day at their desks, their feet swell by 4 to 6 percent by the end of the day. Another study suggested that prolonged quiet sitting might lead to a gradual increase in cardiovascular strain.

In a questionnaire survey of 852 VDT users at New York State government offices in 1985, one-third of the female operators reported frequent or daily neck pain. One-quarter reported back or shoulder pain. For unknown reasons, males reported problems 10 to 20 percent less often than females. Most studies attribute these pains to poor posture caused by nonoptimal seating.

At one time, nearly every source recommended the same posture for working at a PC: back straight, feet firmly flat against the floor, arms at your sides, a 90-degree bend at the elbow, and your wrists straight at the keyboard. Realistically, only Marines and debutantes are likely to sit that way. One reason is office furniture. Except for specially designed ergonomic computer chairs, standard office equipment is typically not designed to adjust to the full range of settings required to accommodate the diversity of human beings. The range is a wide one: A 1982 study reported in the *Journal of Ergology* showed that preferred keyboard height varied from 28 to 34.25 inches and preferred screen height ranged from 36.25 to 45.5 inches.

Moreover, there is substantial doubt that the classic recommendation for seating posture is best for computer users.

> **The health problems associated with computer use in the workplace are well documented and understood, but the preventions and cures rarely escape the laboratory.**

For example, the study cited above showed a preference among VDT workers to lean back so that their bodies were at angles between 97 and 121 degrees. A report published by the Swedish National Board of Safety and Health in 1986 noted that the generally accepted "correct" sitting posture—back straight—is not supported by any scientific evidence. In fact, to relieve pressure on the knees caused by this posture recommendation, furniture has been reduced in height about four inches in the twentieth century, even though people are, on the average, about four inches taller. Raising both tables and chairs by about three inches resulted in reduced back pain and a reduction in leg swelling among workers.

Other studies show that when people are instructed on how to adjust adjustable furniture and then left to their own devices, they rarely assume the textbook-perfect posture. They lean back at up to 31 degrees from the vertical and relax their way through the work day.

The modern viewpoint has superseded the posture police, and adjustable furniture is now available. But even adjustable furniture is problematic. First, it's worthless unless someone shows you how to adjust it—and the process can be complex, because some chairs have 15 separate adjustments! Second, one study seemed to show that it takes about a week to get near to an optimum adjustment of your computer furniture. Third, current advice is running against becoming too comfortable. If you settle so snugly into your chair that you don't want to move, you're likely to develop the sedentary problems you were trying to avoid. You may want to adjust your chair periodically throughout the day, just as you would adjust your driving position periodically on long trips.

IMPLEMENTING SOLUTIONS

The problems described above are well understood and documented, but the preventions and cures rarely escape the laboratory and enter the workplace. The principal reason is ignorance: The people who control the office environment may not be aware of health concerns in the computerized workplace. Couple this ignorance with corporate frugality—any change costs money, and ergonomically designed office equipment is particularly expensive—and you can see why the status quo prevails.

A variety of organizations are trying to counter the ignorance, and have approached the issue from different angles. Among them, the Newspaper Guild has taken the lead among labor unions, since its constituents were among the first to work long days on desktop VDTs. The group Nine to Five campaigns for a safer workplace. National standards-setting organizations have propounded guidelines for equipment and working environments. Even IBM offers guidance on proper workplace ergonomics.

Thanks to the work of these organizations and others, change is coming. In over 30 states, legislation has been introduced to regulate PCs and VDTs in the

workplace. Suffolk County, New York, actually passed such legislation, only to have it immediately become ensnarled in the courts. The strongest measure taken so far was adopted by the forward-thinking city council in San Francisco, which amended its health code on December 10, 1990, with new regulations on the use of VDTs.

The new San Francisco regulations apply primarily to working conditions in the office environment. According to reports in the press, most Bay area employers were appalled by the regulations and hinted they would move from the city because of the financial hardship that complying would impose. The San Francisco standards are based almost entirely on recommendations by ergonomic research, worker advocacy groups, medical professionals, and computer equipment manufacturers.

In the long run, complying with the legislation will undoubtedly benefit employers as well as employees. Eliminating proven hazards should reduce the employers' liability for nontraumatic work-related injury. And, of course, better conditions should increase productivity.

WHAT ABOUT PREGNANCY?

The advertising campaigns that use scare tactics to capitalize on the fears of expectant families usually cite one particular study that linked VDT usage with miscarriages. They rarely go into detail about the study they use to support their dire warnings. That study, reported in 1988 in the *American Journal of Industrial Medicine*, was conducted among 1,583 women who used obstetrical and gynecological clinics affiliated with Kaiser Permanente Medical Care Program in the San Francisco Bay Area. Its design goal was to determine the effect of the insecticide malathion on early pregnancies.

The scientists conducting the study were very thorough and presented participants with a lengthy questionnaire. After crunching the statistics to find correlations, only one result popped out: A higher rate of miscarriage was correlated with women who used VDTs more than 20 hours per week. The researchers noted that the VDTs themselves were not the cause of the miscarriages and attributed the problem to "an occupational effect not related to VDTs," such as stress or working conditions. Recent studies tend to reinforce this conclusion, including a tightly controlled 1989 report published in the *International Journal of Epidemiology*.

Another worrisome development has been the appearance of clusters of miscarriages among VDT workers. For example, at the Dallas computer center of a large retailer, 8 out of 12 pregnancies in which conception occurred between May 1979 and June 1980 terminated in spontaneous abortion or neonatal death. To anyone in the group, these occurrences would seem dire. The national Centers for Disease Control investigated, however, and determined that the problem was not related to proximity to VDTs or the time spent working on them.

Studies show that using a VDT does not increase the risk of having a miscarriage.

To put them in perspective, such clusters don't even rise to the status of statistical aberrations. There are thousands, if not hundreds of thousands of similar groups that work on PCs. A Gaussian distribution of miscarriages among groups would imply that a few groups would have an abnormally high number of miscarriages and a few an abnormally low number. No one notices the low end because nearly everyone expects to have a problem-free pregnancy and a perfect child. Moreover, another factor could be at work—such as a boss with a bullwhip who has elevated workplace stress to an art form.

Pregnant women certainly should be concerned about the various health issues; some sources indicate that up to 20 percent of all pregnancies end in miscarriage, whether or not the mother works at a PC. And, of course, pregnant women are subject to the same health problems that can afflict other PC workers. If you have suitable working conditions and take care of yourself, however, you can rest easy knowing that your PC won't cause you problems. ■

Winn L. Rosch is a contributing editor of PC Magazine.

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by
Jeff Prosise

Utilities

The First DOS 5.0 Utility: UMBFILES Frees Up Extra RAM

DOS 5.0 takes better advantage of your system's extra memory above 640K than any other version of DOS. When the statement DOS=HIGH is in your CONFIG .SYS file, most of DOS itself is loaded into the 64K region of memory known as the *high memory area* or HMA. If there's enough room left over, disk buffers allocated with a BUFFERS= statement in CONFIG.SYS go in the HMA, too.

If you own a 386 or 486, you can also use EMM386.EXE to establish pockets of usable RAM, called *upper memory blocks* or UMBs, in the upper memory area between 640K and 1MB and load TSRs and device drivers there with the LOADHIGH and DEVICEHIGH commands. Furthermore, using new API functions in DOS 5.0, UMB-aware application programs may allocate UMBs for themselves and store data there rather than in conventional memory. But there's still room for improvement. Buffers can be placed in the HMA, but files cannot.

On a system with the statement FILES=40 in CONFIG.SYS, the data structure that DOS creates to store information about open files (called the *system file table*, or SFT) consumes 2.5K of conventional memory. Systems booted with the statement FILES=100 lose more than 5K of conventional memory. If you boot with the maximum number of files, 255, you lose nearly 15K of RAM that could otherwise be used by application programs.

You can fix this with UMBFILES .COM, the utility presented in this column. UMBFILES relocates most of DOS's SFT to upper memory on 386 and 486 systems configured for loading programs and device drivers high. It's just like the FILES directive, except that it works in upper memory, not conventional memory, and it's executed from the command line, not from CONFIG.SYS. Depending on how many files you currently boot with, you can save from 1K of RAM to more than 14K by using UMBFILES.COM. That's like getting an additional 1K to 14K of RAM free. All it costs you is the time it takes to type the program—it's listed in Figure 1—or you can download it from PC MagNet.

■ This issue's utility is one of the first programs to make use of upper memory blocks. In doing so, it can free up as much as 15K of RAM.

Instructions for downloading UMBFILES.COM and its assembly language source code are given in the PC MagNet News page, which follows this article. If you modify the source code, you will need to recompile it using a macro assembler and the following commands:

```
MASM UMBFILES;
LINK UMBFILES;
EXE2BIN UMBFILES UMBFILES.COM
```

If your communications setup can't handle binary files, download UMBFILES.BAS instead. When run in BASIC, this listing will create the .COM file. If you don't have a modem, you can receive a copy of the source code by mail or fax. Send a postcard with your name and address (or fax number if applicable) to the attention of Katherine West, Utilities, *PC Magazine*, One Park Avenue, New York, NY 10016; no phone calls please.

USING UMBFILES

The syntax for UMBFILES is

```
UMBFILES[=]nn
```

where *nn* is the number of files you want to allocate space for in upper memory. Valid values range from 1 to 247. An additional restriction is that the sum of UMBFILES and files already allocated may not exceed 255, because DOS doesn't support more than 255 files open in the system at any one time. For example, if you boot with the statement FILES=20 in CONFIG.SYS and then run UMBFILES, the maximum value UMBFILES will accept for *nn* is 235. If you allocate space for 20 more files with the statement UMBFILES=20 and then run UMBFILES again, the most it will accept is 215.

You can run UMBFILES as many times as you like. Each time, the SFT is extended by the number of entries indicated. You can determine the number of SFT entries the system currently contains (and thus how many files can be open in the system at once) using the NUMFILES utility published in the November 12, 1991, Tutor column. Like UMBFILES, NUMFILES (along with its source code) is available on PC MagNet.

The most efficient way to use UMBFILES is to place the statement FILES=8 in CONFIG.SYS and place a UMBFILES command allocating additional space for files in AUTOEXEC.BAT. For example, if you currently boot with the statement FILES=60, change it to FILES=8 and add the command

```
UMBFILES=52
```

to AUTOEXEC.BAT. Doing so will save you 3,072 bytes (3K) of memory. The 8 SFT entries created by the FILES command will be located in conventional

UMBFILES.ASM 1 of 2

```
;*****************************************************************************
; UMBFILES extends the System File Table (SFT) that DOS uses to track
; the state of open files by creating an extension of the SFT in upper
; memory.  The syntax is
;
;       UMBFILES[=]nn
;
; where "nn" is the number of entries to be created in the SFT extension.
; For best results, boot your system with the statement FILES=8 in CONFIG.-
; SYS, and then allocate room for additional FILES with UMBFILES.  For exam-
; ple, if you now boot with the statement FILES=40, change it to FILES=8 and
; add the statement UMBFILES=32 to your CONFIG.SYS file.  The sum total of
; FILES and UMBFILES cannot exceed 255.
;
; Note: UMBFILES can only be used on 386 and 486 PCs that are running DOS
; 5.0 and are configured for loading TSRs and drivers in upper memory.  To
; accomplish this, you must ensure that, at a minimum:
;
;       1) HIMEM.SYS is loaded
;       2) EMM386.EXE is loaded with a RAM or NOEMS parameter
;       3) CONFIG.SYS contains a DOS=UMB (or DOS=HIGH,UMB) statement
;       4) Your PC contains at least 384K of extended memory
;*****************************************************************************

code            segment
                assume  cs:code,ds:code
                org     100h
begin:          jmp     main

copyright       db      "UMBFILES 1.0 Copyright (c) 1991 Jeff Prosise",13,10
                db      "First published in PC Magazine, November 26, 1991"
                db      13,10,13,10
msg             db      "System File Table extended",13,10,"$"

helpmsg         db      "Builds an extension to the System File Table in "
                db      "upper memory.",13,10,13,10
                db      "UMBFILES[=]nn",13,10,13,10
                db      "  nn    Number of new SFT entries to create."
                db      13,10,13,10
                db      "UMBFILES requires DOS 5.0 and a 386 or 486 PC "
                db      "configured for loading",13,10
                db      "programs and drivers in upper memory.  The sum "
                db      "of FILES and UMBFILES",13,10
                db      "may not exceed 255.",13,10,"$"

errmsg1         db      "Requires DOS 5.x",13,10,"$"
errmsg2         db      "Syntax: UMBFILES[=]nn",13,10,"$"
errmsg3         db      "Invalid parameter or parameter out of range",13,10
errmsg4         db      "FILES plus UMBFILES cannot exceed 255",13,10,"$"
errmsg5         db      "Invalid parameter (cannot be 0)",13,10,"$"
errmsg6         db      "Upper Memory Area not available",13,10,"$"
errmsg7         db      "Insufficient memory",13,10,"$"

umbfiles        dw      0                       ;Number of UMBFILES
strategy        dw      ?                       ;Memory allocation strategy
linkstat        dw      0                       ;Upper memory link status
last_offset     dw      ?                       ;Offset of final SFT header
last_segment    dw      ?                       ;Segment of final SFT header
sftlen          dw      ?                       ;Length of SFT extension

;*****************************************************************************
; Procedure MAIN
;*****************************************************************************

main            proc    near
                cld                             ;Clear direction flag
                mov     si,81h                  ;Point SI to command line
                call    scanhelp                ;Scan for "/?" switch
                jnc     main1                   ;Branch if not found

                mov     ah,09h                  ;Display help text and exit
                mov     dx,offset helpmsg       ;  with ERRORLEVEL=0
                int     21h
                mov     ax,4C00h
                int     21h
;
; Check the DOS version and abort if it's not 5.x.
;
main1:          mov     ah,30h                  ;Get DOS version
                int     21h
                cmp     al,5                    ;Branch if the major version
                mov     dx,offset errmsg1       ;  number is 5, abort if
                je      main2                   ;  it's not

error:          mov     ah,9                    ;Display error message
                int     21h
                mov     ax,4C01h                ;Exit with ERRORLEVEL=1
                int     21h
;
; Parse the command line to determine how many SFT entries to create.
;
main2:          call    findchar                ;Advance to next character
                mov     dx,offset errmsg2       ;Error if EOL encountered
                jc      error

                call    asc2bin                 ;Convert ASCII to binary
                mov     dx,offset errmsg3       ;Error if carry is set on
                jc      error                   ;  return
                mov     dx,offset errmsg5       ;Error if number was 0
                or      al,al
                jz      error
                mov     byte ptr umbfiles,al    ;Save UMBFILES number
;
; Walk the chain of SFT headers to determine how many FILES already exist.
;
                xor     cx,cx                   ;Zero SFT entry count
                mov     ah,52h                  ;Get address of DOS's List
                int     21h                     ;  of Lists
                mov     di,es:[bx+4]            ;Place address of first SFT
                mov     es,es:[bx+6]            ;  header in ES:DI

main3:          mov     last_offset,di          ;Save the address of this
                mov     last_segment,es         ;  header
                add     cx,es:[di+4]            ;Add number of SFT entries
                                                ;  in this block
                mov     bx,es:[di]              ;Place address of next SFT
                mov     es,es:[di+2]            ;  header in ES:DI and loop
                mov     di,bx                   ;  if the offset address
                cmp     di,0FFFFh               ;  isn't equal to FFFFh
                jne     main3

                add     cx,umbfiles             ;Verify that FILES plus
                mov     dx,offset errmsg4       ;  UMBFILES is less than
                cmp     cx,255                  ;  255 and abort if it's
                ja      error                   ;  not
;
; Allocate an upper memory block to hold the SFT extension.
;
                mov     ax,5802h                ;Get the current UMB link
                int     21h                     ;  status and save it
                mov     byte ptr linkstat,al

                mov     ax,5803h                ;Set UMB link
                mov     bx,1
                int     21h
                mov     dx,offset errmsg6       ;Error if carry returns set
                jc      error

                mov     ax,5800h                ;Get the current memory
                int     21h                     ;  allocation strategy
                mov     strategy,ax             ;  code and save it

                mov     ax,5801h                ;Change to high-only, best-
                mov     bx,41h                  ;  fit allocation strategy
                int     21h
                mov     dx,offset errmsg6       ;Error if carry returns set
                jnc     main4

error1:         jmp     error

main4:          mov     al,59                   ;Compute the number of
                mul     byte ptr umbfiles       ;  paragraphs of memory
                mov     sftlen,ax               ;  required for the SFT
                add     ax,21                   ;  extension
                mov     cl,4
                shr     ax,cl
                mov     bx,ax
                mov     ah,48h                  ;Request the memory through
                int     21h                     ;  DOS function 48h
                mov     dx,offset errmsg7       ;Error if allocation request
                jc      error1                  ;  is denied

                dec     ax                      ;Point ES to MCB preceding
                mov     es,ax                   ;  the memory block
                mov     word ptr es:[01h],08h   ;Change owner ID to 08h
                inc     ax                      ;Point ES back to the block
                mov     es,ax                   ;  itself

                mov     ax,5801h                ;Restore original memory
                mov     bx,strategy             ;  allocation strategy
                int     21h

                mov     ax,5803h                ;Restore original UMB
                mov     bx,linkstat             ;  link status
                xor     bh,bh
                int     21h
;
; Initialize the new SFT block and link it into the chain.
;
                mov     word ptr es:[00h],0FFFFh        ;Initialize the
                mov     word ptr es:[02h],0000h         ;  SFT header
                mov     ax,umbfiles
                mov     word ptr es:[04h],ax

                mov     cx,sftlen               ;Load CX with SFT length
                xor     al,al                   ;Fill the new SFT with
                mov     di,06h                  ;  zeroes from start to
                rep     stosb                   ;  finish

                mov     ax,es                   ;Place the address of the
                mov     di,last_offset          ;  new SFT header in the
                mov     es,last_segment         ;  header of the last
                mov     word ptr es:[di],00h    ;  one
                mov     word ptr es:[di+2],ax
;
; Display message verifying that the operation is completed, and then exit.
;
                mov     ah,09h                  ;Display message
                mov     dx,offset copyright
                int     21h
                mov     ax,4C00h                ;Exit with ERRORLEVEL=0
                int     21h
main            endp

;*****************************************************************************
```

Figure 1: The source code listing for UMBFILES, a utility that saves you RAM by placing most of the system file table (SFT) in upper memory.

UMBFILES.ASM 2 of 2

```
; SCANHELP scans the command line for a /? switch.  If found, carry returns
; set and SI contains its offset.  If not found, carry returns clear.
;*************************************************************************

scanhelp        proc    near
                push    si                      ;Save SI
scanloop:       lodsb                           ;Get a character
                cmp     al,0Dh                  ;Exit if end of line
                je      scan_exit
                cmp     al,"?"                  ;Loop if not "?"
                jne     scanloop
                cmp     byte ptr [si-2],"/"     ;Loop if not "/"
                jne     scanloop

                add     sp,2                    ;Clear the stack
                sub     si,2                    ;Adjust SI
                stc                             ;Set carry and exit
                ret

scan_exit:      pop     si                      ;Restore SI
                clc                             ;Clear carry and exit
                ret
scanhelp        endp

;*************************************************************************
; FINDCHAR advances SI to the next non-white space character.  On return,
; carry set indicates EOL was encountered; carry clear indicates it was not.
;*************************************************************************

findchar        proc    near
                lodsb                           ;Get the next character
                cmp     al,09h                  ;Loop if tab
                je      findchar
                cmp     al,20h                  ;Loop if space
                je      findchar
                cmp     al,2Ch                  ;Loop if comma
                je      findchar
                cmp     al,3Dh                  ;Loop if equal sign
                je      findchar
                dec     si                      ;Point SI to the character
                cmp     al,0Dh                  ;Exit with carry set if end
                je      eol                     ;  of line is reached

                clc                             ;Clear carry and exit
                ret

eol:            stc                             ;Set carry and exit
                ret
findchar        endp

;*************************************************************************
; ASC2BIN converts a decimal number entered in ASCII form into a binary
; value in AL.  Carry set on return indicates that an error occurred in
; the conversion.
;*************************************************************************

asc2bin         proc    near
                sub     ax,ax                   ;Initialize registers
                sub     bh,bh
                mov     dl,10

a2b_loop:       mov     bl,[si]                 ;Get a character
                inc     si
                cmp     bl,20h                  ;Exit if space
                je      a2b_exit
                cmp     bl,2Ch                  ;Exit if comma
                je      a2b_exit
                cmp     bl,0Dh                  ;Exit if carriage return
                je      a2b_exit

                cmp     bl,"0"                  ;Error if character is not
                jb      a2b_error               ;  a number
                cmp     bl,"9"
                je      a2b_error

                mul     dl                      ;Multiply the value in AL by
                jc      a2b_error               ;  10 and exit on overflow
                sub     bl,30h                  ;ASCII => binary
                add     ax,bx                   ;Add latest value to AX
                cmp     ax,255                  ;Error if sum > 255
                jna     a2b_loop                ;Loop back for more

a2b_error:      dec     si                      ;Set carry and exit
                stc
                ret

a2b_exit:       dec     si                      ;Clear carry and exit
                clc
                ret
asc2bin         endp

code            ends
                end     begin
```

memory; the 52 set up by UMBFILES will be in upper memory. Why not place all 60 in upper memory? The minimum value DOS will accept for FILES is 8, so the first 8 SFT entries must always be in conventional memory. Any entries beyond that may be placed in upper memory with UMBFILES.

To use UMBFILES, you must be running DOS 5.0 and have a 386 or 486 configured for loading programs and device drivers in upper memory. At a minimum, this means that:

- You must load HIMEM.SYS in CONFIG.SYS;
- You must also load EMM386.EXE with a RAM or NOEMS parameter;
- CONFIG.SYS must contain the statement DOS=UMB (or DOS=HIGH, UMB);
- Your PC must contain at least 384K of extended memory.

If UMBFILES reports that the upper memory area is not available, then it was unable to allocate a block of upper memory—probably because your system isn't set up properly for UMBs. If this happens, check your CONFIG.SYS file to make sure it contains the required statements and that EMM386.EXE is indeed being loaded with a RAM or NOEMS parameter. Without one of these two parameters, EMM386.EXE will not create the upper memory blocks that UMBFILES needs.

If UMBFILES reports "Insufficient memory," it means that the upper memory area is available but there isn't a UMB large enough to hold the number of SFT entries you requested. To determine the size of the largest free UMB, just type MEM /C. If there is some unallocated upper memory remaining, you may be able to use it by decreasing the requested number of SFT entries. You should note that each entry requires approximately 59 bytes of upper memory.

Other error messages from UMBFILES include "Sum of FILES and UMBFILES cannot exceed 255," indicating that the number of additional SFT entries that you requested would push the total to more than 255, and "Invalid parameter (cannot be 0)," which you get if you type UMBFILES=0. UMBFILES will also respond with an error message if the number you enter for *nn* is invalid (for example, if the entry contains any nonnumeric characters), if you attempt to run it with any version of DOS other than 5.*x*, or if there is a syntax error. If UMBFILES succeeds in extending the SFT, it will display the message "System File Table extended," indicating that the entries you requested were added to the SFT.

A final note concerning the use of UMBFILES relates to its on-line help feature. You can get help with any DOS 5.0 command by running it with a /? switch. Similarly, you can get help with UMBFILES by typing

```
UMBFILES /?
```

In response, UMBFILES displays a one-line description of itself followed by a description of its syntax and other helpful information.

HOW UMBFILES WORKS

If you read the November 12, 1991, Tutor column, you're already familiar with the system file table and how it is used. DOS uses the SFT to store information about files opened with the operating system's handle-based file functions. When a file is opened, DOS places the number of the SFT entry that corresponds to the file in another table called a job file table, or JFT, which is located in the program segment prefix (PSP) of the program that opened it.

The offset that the number is placed at relative to the base of the JFT becomes the *file handle*.

The SFT entry itself contains the name of the file, the date and time it was created or last modified, the current position of the file pointer, a record of the access rights the file was opened with, and other information. When the file is eventually closed, the slots that it occupied in the SFT and the JFT are freed for use by a subsequent file. Thus, the number of SFT entries created at start-up ultimately limits the number of files that can be open in the system concurrently; if all the SFT entries are currently in use, DOS will fail further requests to open a file.

Physically, the SFT is rarely (if ever) stored in one block of memory. Instead, it is divided into two or more blocks, each containing a 6-byte header that specifies the segment:offset address of the next SFT block header and the number of SFT entries in the current block. Together, the SFT blocks defined in the system form a linked list that is easily extended to add SFT entries. DOS divides the SFT into two blocks. The first one contains space for five SFT entries, the second one contains space for the rest.

In the header for the second block, the field that holds the offset address of the next header in the chain contains the value FFFFh, indicating that no more SFT blocks follow this one. UMBFILES allocates a block of memory that will become the third SFT block in the chain, initializes it by filling in the header and writing 0s to the SFT entries themselves, and patches the address of the newly allocated block into the header preceding the second block. Thus the chain of SFT blocks is amended so that DOS has an increased number of entries to choose from when a program asks to open a file.

This may sound like tricky business, but it's not. The architects of DOS probably structured the SFT as they did so it could be extended after the system is booted. *Windows* extends the SFT to the equivalent of FILES=30 if you boot with FILES=20. So in reality, UMBFILES isn't doing anything that's not condoned by Microsoft. It's just taking advantage of undocumented features of DOS—a practice that Microsoft wouldn't approve of but that its own products such as *Windows* take advantage of in order to make DOS more extensible.

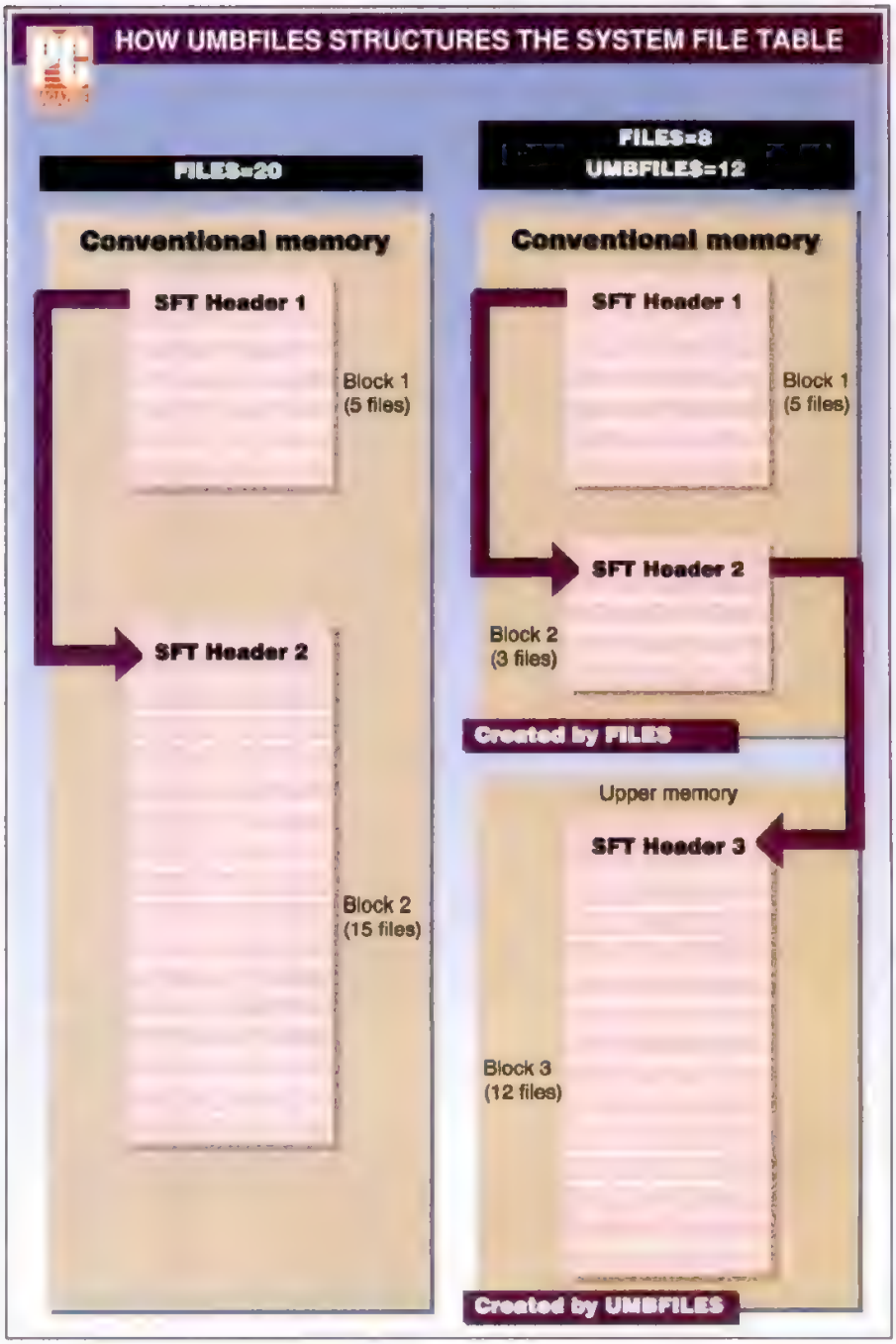

Figure 2: When you boot with FILES=20, the SFT is divided into two blocks. One holds 5 SFT entries; the other holds 15. Both reside in conventional memory. With FILES=8 and UMBFILES=12, the SFT is divided into 3 units. The first two hold 5 and 3 SFT entries, respectively. They, too, are located in conventional memory. The third block, which contains space for 12 additional files, is located in upper memory, where it doesn't take away memory from application programs running in the lower 640K.

Figure 2 compares the structure of the system file table when you boot with the statement FILES=20 in CONFIG.SYS with the structure it assumes when you boot with FILES=8 and extend the SFT with UMBFILES=12. In both cases, DOS will permit 17 files to be open in the system at once (3 are reserved for the devices CON, AUX, and PRN). The second configuration consumes less conventional memory because 12 of the 20 SFT entries are allocated in upper memory.

With FILES=20, the SFT is divided into two blocks. One holds 5 SFT entries;

PC MAGAZINE UTILITIES UPDATES

Like all good software, the programs presented in *PC Magazine* are upgraded and improved. You can get the modified versions by downloading them from PC MagNet. Here's a partial list of the programs that have been upgraded to fix minor bugs and system incompatibilities:

ANSI.COM, Version 1.3
BAT2EXEC.COM, Version 1.3
BCOPY, Version 1.2
BEN56.ARC (Benchmark Series, Version 5.6)
CARDFILE.COM, Version 1.1
CHKFRAG.EXE, Version 1.2
CMDEDIT.EXE, Version 2.1
CONFIG.CTL, Version 3.0
DIRMATCH.COM, Version 2.0
EMMA.COM, Version 2.2
EMS40.SYS, Version 1.1
PANDORA.COM, Version 1.5a
PCACCESS.COM, Version 1.1
PCMANAGE.EXE, Version 1.1
PCREMOTE.COM, Version 1.1
RN.COM, Version 2.0
SCHEDULE.COM, Version 1.1
SLICE.COM, Version 1.3
SNIPPER.COM, Version 1.2
TPFST-AT.COM, Version 1.1
ZCOPY.COM, Version 1.2

For a complete list of all the programs available from the PC MagNet Software and Utilities Database Library, download UDCAT.ARC.

A downloadable index to *PC Magazine*'s product reviews is also available. PCM.EXE is a self-extracting file that contains the *Computer Library PC Magazine* Reviews Index for January 1988 to December 1990. It requires the search files in PCSRCH.EXE. Please read the information file PCM.INF before you download any of these files.

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the other holds 15. Both of these blocks reside in conventional memory. With FILES=8 and UMBFILES=12, the SFT is divided into three blocks. The first two, holding 5 and 3 SFT entries, respectively, are located in conventional memory. The third block, which contains space for 12 additional files, is located in upper memory, where it doesn't take away memory from application programs running in the lower 640K.

ACCESSING UPPER MEMORY

The only thing that's the least bit unusual about UMBFILES is that it allocates space for the extended SFT in upper memory. To do so, it relies on two new and two modified API functions in DOS 5.0. The new ones, functions 5802h and 5803h, get and set the UMB link status—an internal flag that determines whether upper memory is treated as a logical extension of conventional memory or whether it is ignored. The modified ones, functions 5801h and 5800h, determine the memory allocation strategy DOS will use when it receives a request for memory. All four functions are accessed through interrupt 21h.

When you include the statement DOS=UMB in CONFIG.SYS, DOS uses the HIMEM.SYS driver to claim all the UMBs created by EMM386.EXE for itself so that it has sole access rights to them (for a discussion of HIMEM.SYS and the functions it provides for allocating and deallocating UMBs, refer to the December 11, 1990, Tutor column). To manage the memory in this region, it sets up a series of memory control blocks just like the ones it sets up in conventional memory (for more on memory control blocks and how they're used to profile memory, see the April 16, 1991, Tutor column).

UMBFILES relies on two new and two modified API functions in DOS 5.0.

The chain of MCBs that DOS sets up for upper memory is separate from the chain it sets up for conventional memory. Because there is no connection between the two, DOS ignores upper memory when it searches for free memory to satisfy a request placed through function 48h (Allocate Memory). However, calling function 5803h with BX set to 1 establishes a logical link between upper and lower memory so that both are searched. Calling function 5803h with BX equal to 0 unlinks upper memory, setting it back to the default. The counterpart to this function, function 5802h, returns the current UMB link status in AL (0=off, 1=on).

Once the upper memory area is linked, requests for memory placed through function 48h may be fulfilled with either conventional or upper memory. By default, DOS searches the lower 640K first, turning to memory above 640K if the search fails to turn up a block of RAM large enough to meet the request. This is called a *low-first* allocation strategy. If you're interested in allocating upper memory, you can switch to a *high-first* strategy by calling function 5801h with bit 7 of BX set to 1, or to a *high-only* strategy by setting bit 6 to 1. These bit settings are summarized in Figure 3.

The value in bits 0 and 1 determines how DOS will proceed with the search for free memory. Both bits OFF selects a first-fit strategy that scans the memory allocation chain from the bottom up, stopping at the first block whose size is equal to or larger than the one requested; Bit 0 ON and bit 1 OFF selects a best-fit strategy, which examines all available memory blocks and uses the one that most closely matches the size of the one requested; bit 0 OFF and bit 1 ON is a last-fit strategy that scans the allocation chain from the top down, again stopping at the first block whose size is equal to or larger than the one requested.

The two regions of memory are treated separately as the search for free memory proceeds. For example, when a low-first, last-fit allocation strategy is in effect, DOS searches from the top of conventional to the bottom, and then from the top of upper memory to the bottom. The counterpart to function 5801h, function 5800h, returns the value indicating the current allocation strategy in AX.

UMBFILES calls functions 5802h and 5800h to get the current allocation strategy and UMB link status and then uses functions 5803h and 5801h to link upper memory and switch to a high-only, best-fit allo-

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DOS 5.0 MEMORY ALLOCATION STRATEGY CODES

Bits 8–15	Reserved (should be 0)
Bits 6–7	Low/high selector 00 = Low first 01 = High only 10 = High first
Bits 2–5	Reserved (should be 0)
Bits 0–1	First-fit/last-fit/best-fit selector 00 = First fit 01 = Best fit 10 = Last fit

Figure 3: Mapping of the word passed to DOS function 5801h (Set Allocation Strategy) in BX. Bits 6 and 7 determine whether DOS will search upper or lower memory first (or upper memory only) when searching for free memory to satisfy an allocation request. Bits 0 and 1 determine whether a first-fit, best-fit, or last-fit strategy is used within each area that is searched. The value 82h (binary 10000010) selects a high-first, last-fit memory allocation strategy. Upper memory will be included in the search only if it was linked earlier by placing a call to DOS function 5803h with BX set to 1.

cation strategy. Then it computes the size of the UMB it needs by multiplying the number of entries in the extended SFT by 59, adding 21 to the result (to account for the 6 bytes needed for the SFT header, plus 15 more bytes to ensure that it isn't short-changed when it converts bytes to paragraphs), and then dividing by 16. The result is the number of paragraphs of memory required.

To acquire a block of upper memory, it calls function 48h with the number of paragraphs requested in BX—just as it would if it were allocating conventional memory. If a sufficient amount of upper memory is available, DOS returns the segment address of the allocated UMB in register AX. Carry set on return from function 48h means there was not enough upper memory to allocate the block. When this occurs, UMBFILES terminates after displaying the message "Insufficient memory."

Before it adds the UMB to the SFT, UMBFILES restores the allocation strategy and UMB link status that were in effect when it was started. Then it initializes the UMB by creating an SFT header in the first 6 bytes and filling in everything after it with 0s. Finally, it links the UMB into the chain of SFT headers. To do so, it calls on undocumented DOS function 52h (Get List of Lists), which returns the segment: offset address of the first SFT header at ES:[BX+4]. This function, which we've discussed in Tutor many times, holds a treasure chest of information about DOS internals that isn't available by any other means. UMBFILES walks the chain of SFT headers until it locates the last one, and then copies the address of the UMB to the final header.

With that, UMBFILES's work should be done—but one problem remains. When a process terminates, DOS automatically frees up all the memory allocated to it, including any UMBs it owns. To prevent DOS from returning the UMB that was just allocated to the free memory pool, UMBFILES plays a trick on DOS: It sets the value in the owner field of the MCB to 08h (the owner ID that DOS assigns to memory blocks allocated at start-up) so that the UMB's relationship to UMBFILES is no longer traceable.

How does this work? The word at offset 01h in every MCB contains the PSP address of the process that owns the ensuing memory block. A value of 0 means the block is unallocated. When DOS terminates a program, it scans the allocation chains in upper and lower memory for MCBs that contain the PSP address of the terminating program. Those it finds, it deallocates. By modifying the MCB value that identifies UMBFILES as the UMB's owner, UMBFILES fools DOS into thinking that someone else owns the block and prevents it from being released. The extended SFT stays behind in memory, as it was intended to—and DOS is no wiser.

UMB-AWARE APPLICATIONS

UMBFILES is one of the first programs to make use of UMBs. Soon, we should see other utilities and application programs that use upper memory to break the 640K barrier. The relief is limited, but on some systems DOS 5.0 can make as much as 130K of extra memory available through the EMM386.EXE driver and pass that memory on to programs in the form of UMBs. In an environment in which only 1K or 2K can determine whether a large application program will run, even that modest amount of memory is too significant to ignore. ■

Jeff Prosise is a contributing editor of PC Magazine.

PC MagNet News

The Latest Files and Features of PC Magazine's On-line Service

Conquer Special Characters in Word For Windows

If you've ever tried to print a special character in *Word for Windows*—a bullet, a trademark symbol, or any of the ANSI special characters—you know that there's got to be a better way.

Dinger, a *Word for Windows* macro, is it.

Written by Woody Leonhard, a regular visitor to MagNet's on-line forums, Dinger is a macro that's distributed as shareware. Download it, and if you find that it makes your life easier, send a $19 payment to the author.

You can download the file DNGR20.ZIP from MagNet's UtilForum (GO UTILFORUM) in DL15, Working Word.

And if you've ever tried to print an address using a LaserJet and *Word for Windows* and ruined an envelope, you'll want a copy of Leonhard's ENVLOP.ZIP.

It's a macro that installs itself on the menu bar. When you've got an address you want to print on an envelope, simply select the macro from the menu and highlight it. You'll have three choices for return address styles, and you can insert handling options, like Special Delivery or Air Mail. Best of all, you won't be wasting any more of your envelopes, since Leonhard's macro lets you insert the envelope face down every time, no matter which laser printer you use.

You can download ENVLOP.ZIP (Shareware, $29) from DL14, ASP Utils, of the UtilForum.

WINCOLOR Is the Most Popular Download

The most popular file on PC MagNet was *PC Magazine*'s own WINCOLOR, a utility that allows for easier color control in your *Windows* 3.0 setup.

Another *PC Magazine* utility, the useful STRINGS, was the second most-popular download. This program allows you to expand your batch file versatility by "stringing" along various batches.

The catalog of all *PC Magazine* files, PCMCAT.ZIP, was third in the summer download race. It was trailed by the PKZ110.EXE unzipping utility and the September 10, 1991, *PC Magazine* volume archive, V10N15.ZIP.

1. WINCOLOR.EXE
2. STRINGS.COM
3. PCMCAT.ZIP
4. PKZ110.EXE
5. V10N15.ZIP

These numbers were accumulated by a download tally of the Software and Utility Library. The SOFTLIB was especially busy this summer, thanks in part to an expansion that incorporated hundreds of new files.

You can download these and every other *PC Magazine* file from our Software and Utility Library (GO SOFTLIB).—*Chris Parker*

- **CONQUER SPECIAL CHARACTERS IN WORD FOR WINDOWS: A shareware macro brings ANSI characters into reach.**
- **WINCOLOR IS THE MOST POPULAR DOWNLOAD: The *PC Magazine* utility led all others over the summer months.**

Instant Access to PC Magazine's On-line Service

PC Magazine operates a 24-hour-a-day interactive dial-up service where readers can find the utilities published in every issue, download an index of all product reviews, share opinions with the editors, and gain access to Computer Library and Consumer Reference Library.

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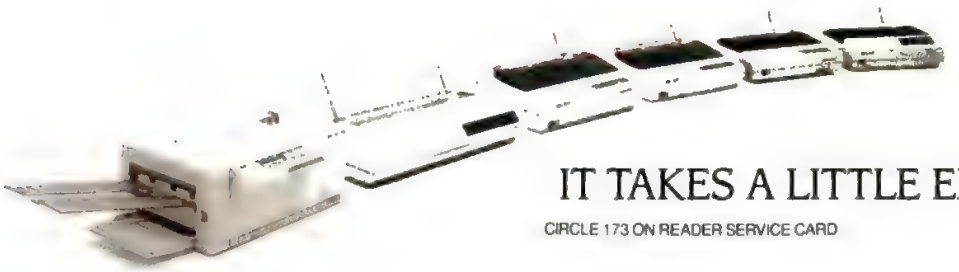

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CIRCLE 173 ON READER SERVICE CARD

by
Charles Petzold

Environments

Exploring Waveform Audio: Generating Sine Waves in Software

■ Multimedia *Windows* furnishes applications with a device-independent API for using waveform audio hardware. Here's a program that provides an introduction.

The Multimedia Extensions to *Windows* 3.0 give programs the ability to capture, process, store, and output sound. This facility is known as waveform audio, the basics of which I discussed in the last issue. You'll recall that the Multimedia *Windows* hardware can pick up sound through a microphone and pass it through an analog-to-digital converter (ADC) to convert the sound to numbers representing the waveform amplitude over time. On the output side, these numbers can be passed through a digital-to-analog converter (DAC) to convert the numbers back into an electrical analog waveform suitable for amplification.

Multimedia *Windows* provides programs with a device-independent API (application program interface) for using the waveform audio hardware. In this column, I'll begin discussing this "low-level" waveform audio API, which involves functions beginning with the prefix wave. In later columns, we'll look at the high-level API, which involves the Media Control Interface (MCI).

For now, I'll restrict myself to waveform audio output and the functions beginning with the prefix waveOut. The sample program is an audio sine wave generator called SINEWAVE. This program uses the waveform audio hardware to generate sine waves from 20 Hz (the bottom of human perception) to 5,000 Hz (two octaves short of the top of human perception) in 1-Hz increments.

WRONG WAYS AND RIGHT WAYS

The standard C runtime library includes a function called sin that returns the sine of an angle given in radians. (2π radians = 360°.) The sin function returns a value ranging from -1 to 1. Thus it should be easy to use the sin function to generate sine wave data to output to the Multimedia *Windows* waveform audio hardware. Basically, you fill a buffer with data representing the waveform (in this case a sine wave) and then pass it to the API. (It's actually a little more complicated than that, but I'll get to the details shortly.) When the waveform audio hardware finishes playing the buffer, you pass it a second buffer, and so forth.

At first, it might seem reasonable to divide one cycle of the sine wave into a fixed number of samples, say 360. For a 20-Hz sine wave, you output 7,200 samples every second. For a 200-Hz sine wave, you output 72,000 samples per second. That might work, but it's not the way to do it. For a 5,000-Hz sine wave, you'd need to output 1,800,000 samples per second, which would surely tax the DAC! Moreover, for the higher frequencies, this is far more precision than is needed.

With pulse code modulation (the type of waveform audio supported under Multimedia *Windows*), the sample rate is a constant. Multimedia *Windows* supports sample rates of 11,025, 22,050, and 44,100 Hz. Let's assume the sample rate is 11,025 Hz—that's what I use in the SINEWAVE program.

To generate a sine wave of 5,512.5 Hz (exactly half the sample rate), each cycle of the sine wave requires just two samples. For a sine wave of 25 Hz, each cycle needs 441 samples. In general, the number of samples per cycle is the sample rate divided by the desired sine wave frequency. Once you know the number of samples per cycle, you can divide 2π radians by that number and use the sin function to get the samples for one cycle. Then just

THE FILLBUFFER FUNCTION — COMPLETE LISTING

```
VOID FillBuffer (LPBYTE pBuffer, int iFreq)
    {
    static double fAngle ;
    int           i ;

    for (i = 0 ; i < BUFFER_SIZE ; i++)
        {
        pBuffer [i] = (BYTE) (127 + 127 * sin (fAngle)) ;

        fAngle += 2 * PI * iFreq / SAMPLE_RATE ;

        if (fAngle > 2 * PI)
            fAngle -= 2 * PI ;
        }
    }
```

Figure 1: Here's one way to fill an 8-bit-per-sample buffer with sine wave data.

repeat the samples for one cycle over and over again to create a continuous waveform.

However, the number of samples per cycle may well be fractional, so this approach won't work well either. You'd get a discontinuity at the end of each cycle.

Are you ready to hear the right way to do it? The key is to maintain a static "phase angle" variable. This angle is initialized at 0. The first sample is the sine of 0. The phase angle is then incremented by 2π times the frequency, divided by the sample rate. Use this phase angle for the second sample and continue in this way. Whenever the phase angle gets above 2π radians, subtract 2π radians from it. But don't ever reinitialize it to 0.

For example, suppose you want to generate a sine wave of 1,000 Hz with a sample rate of 11,025 Hz. That's about 11 samples per cycle. The phase angles (and here I'll give them in degrees so it is more comprehensible) for approximately the first cycle and a half are 0, 32.65, 65.31, 97.96, 130.61, 163.27, 195.92, 228.57, 261.22, 293.88, 326.53, 359.18, 31.84, 64.49, 97.14, 129.80, 162.45, 195.10, and so forth. The waveform data you put in the buffer are the sines of these angles, scaled to the number of bits per sample. When creating the data for a subsequent buffer, keep incrementing the last phase angle value without reinitializing it to 0.

Figure 1 shows some C code with a FillBuffer function that fills a buffer with 8-bit-per-sample sine wave data in preparation for sending it out to the waveform audio hardware. The BUFFER_SIZE, SAMPLE_RATE, and PI identifiers are defined elsewhere in the program. The iFreq parameter to FillBuffer is the desired frequency in Hz. Notice that the result of the sin function is scaled to range between 0 and 254. For each sample, the fAngle parameter to the sin function is increased by 2π radians times the desired frequency divided by the sample rate.

This is not the FillBuffer function I used in the final version of my SINEWAVE program. I decided that calling sin and performing other floating-point calculations for each sample was too much of a drain on the system. It worked on my machine, but I doubt it would be suitable for a Multimedia *Windows* minimum standard 12-MHz 286 box, particularly one without a math coprocessor installed. I'll discuss my final version of FillBuffer a bit later.

Figure 2: This screen shot shows the SINEWAVE window.

SINEWAVE.MSC — COMPLETE LISTING

```
#-----------------------------------------
# SINEWAVE.MSC make file for Microsoft C 6.0
#-----------------------------------------

sinewave.exe : sinewave.obj sinewave.def sinewave.res
     `link sinewave,, NUL, /nod slibcew libw win87em mmsystem, sinewave
     rc -t sinewave.res

sinewave.obj : sinewave.c sinewave.h
     cl -c -G2sw -Ow -W3 -Zp sinewave.c

sinewave.res : sinewave.rc sinewave.h
     rc -r sinewave.rc
```

Figure 3: This is a make file for the Microsoft C 6.0 compiler and the *Windows* Software Development Kit.

SINEWAVE.BCP — COMPLETE LISTING

```
#-----------------------------------------
# SINEWAVE.BCP make file for Borland C++ 2.0
#-----------------------------------------

sinewave.exe : sinewave.obj sinewave.def sinewave.res
     tlink /c /n /Tw /Lc:\borlandc\lib c0ws sinewave, sinewave, NUL, \
           /nod cwins cs import maths mmsystem, sinewave
     rc -t sinewave.res

sinewave.obj : sinewave.c sinewave.h
     bcc -c -w-par -W -2 sinewave.c

sinewave.res : sinewave.rc sinewave.h
     rc -r -ic:\borlandc\include sinewave.rc
```

Figure 4: This is a make file for the Borland C++ 2.0 compiler.

THE SINEWAVE PROGRAM

You can see the SINEWAVE window in Figure 2. Figures 3 through 7 show all the source code files for the program. I've provided make files for both the Microsoft C 6.0 compiler with the *Windows* Software Development Kit, and the Borland C++ 2.0 compiler. If you're familiar with the compiler flags, you'll note that I've allowed for the 286 instruction set, and I've used the -t flag on the resource compiler so the program runs in protected mode only. Because Multimedia *Windows* requires a 286 and 2MB of memory, this is a reasonable restriction.

If you have the Microsoft tools installed, you can create SINEWAVE.EXE by running:

```
NMAKE SINEWAVE.MSC
```

If you're using the Borland compiler, run the following:

```
MAKE -fSINEWAVE.BCP
```

In either case, you also need the Multimedia Development Kit (MDK). The SINEWAVE.BCP file assumes that the

MDK has been installed in the Borland C++ directories. In particular, MMSYSTEM.H must be in the INCLUDE subdirectory and MMSYSTEM.LIB must be in the LIB subdirectory.

You can also download the source code and the SINEWAVE.EXE executable from PC MagNet. This may be obvious, but I'll remind you anyway: SINEWAVE won't run under *Windows* unless you have the Multimedia Extensions installed.

SINEWAVE uses a technique of defining a dialog box template in SINEWAVE.RC for the program's main window. In WinMain, SINEWAVE.C creates a modal dialog box based on this template and on the dialog procedure DlgProc. This technique helps to keep some of the code bulk down.

As shown in Figure 2, SINEWAVE's window contains three controls: a horizontal scroll bar used for selecting the frequency, a static text field that indicates the currently selected frequency, and a push button labeled "Turn On." When you press the button, you should hear a sine wave from the speakers connected to your audio hardware, and the button text changes to "Turn Off." You can change the frequency by moving the scroll bar with the keyboard or mouse. To turn off the sound, push the button again.

During the WM_INITDIALOG message, DlgProc initializes the scroll bar so the minimum frequency is 20 Hz and the maximum frequency is 5,000 Hz. Initially, the scroll bar is set to 440 Hz. In musical terms, this is the A above middle C, the note used for tuning an orchestra. DlgProc receives WM_HSCROLL messages when the user manipulates the scroll bar. DlgProc alters the static variable iFreq on receipt of these messages. Notice that PgUp and PgDn cause DlgProc to alter the frequency by one octave.

OPENING WAVEFORM OUTPUT

Whenever DlgProc receives a WM_COMMAND message from the button, it first allocates and locks three sharable global memory buffers, one for a WAVEHDR structure (which I'll discuss later in this column) and two for buffers (called pBuffer and pBuffer2) to hold the waveform data. The WAVEHDR structure and the data buffers must be global sharable memory blocks.

SINEWAVE opens waveform audio for output by calling the waveOutOpen function, which uses the following parameters:

SINEWAVE.C — 1 OF 2

```
/*-------------------------------------------------------
   SINEWAVE.C -- Multimedia Windows Sine Wave Generator
                 (c) Charles Petzold, 1991
  -------------------------------------------------------*/

#include <windows.h>
#include <mmsystem.h>
#include <math.h>
#include "sinewave.h"

#define SAMPLE_RATE      11025
#define FREQ_MIN            20
#define FREQ_MAX          5000
#define FREQ_INIT          440
#define BUFFER_SIZE       2048
#define SINE_TABLE_SIZE   2048
#define PI                   3.14159

#define GlobalShareAlloc(dwSize) GlobalAlloc (GHND | GMEM_SHARE, dwSize)

BOOL FAR PASCAL DlgProc (HWND, WORD, WORD, LONG) ;

static char szAppName [] = "SineWave" ;

int PASCAL WinMain (HANDLE hInstance, HANDLE hPrevInstance,
                    LPSTR lpszCmdLine, int nCmdShow)
     {
     FARPROC lpDlgProc ;

     lpDlgProc = MakeProcInstance (DlgProc, hInstance) ;
     DialogBox (hInstance, szAppName, NULL, lpDlgProc) ;
     FreeProcInstance (lpDlgProc) ;

     return 0 ;
     }

VOID FillBuffer (LPBYTE pBuffer, int iFreq)
     {
     static BOOL   bSineTableSet ;
     static BYTE   bySineTable [SINE_TABLE_SIZE] ;
     static DWORD  dwAngle ;
     int           i ;

     if (!bSineTableSet)
          {
          for (i = 0 ; i < SINE_TABLE_SIZE ; i++)
               bySineTable [i] = (BYTE) (127 + 127 *
                                         sin (i * 2 * PI / SINE_TABLE_SIZE))
          bSineTableSet = TRUE ;
          }

     for (i = 0 ; i < BUFFER_SIZE ; i++)
          {
          pBuffer [i] = bySineTable [dwAngle >> 8] ;
          dwAngle += 256UL * SINE_TABLE_SIZE * iFreq / SAMPLE_RATE ;

          if (dwAngle > 256L * SINE_TABLE_SIZE)
               dwAngle -= 256L * SINE_TABLE_SIZE ;
          }
     }

BOOL FAR PASCAL DlgProc (HWND hwnd, WORD message, WORD wParam, LONG lParam)
     {
     static BOOL          bShutOff, bClosing ;
     static char          szOpenError[] = { "Error opening waveform audio!" } ;
     static char          szMemError [] = { "Error allocating memory!" } ;
     static GLOBALHANDLE  hWaveHdr, hBuffer, hBuffer2 ;
     static HWAVEOUT      hWaveOut ;
     static HWND          hwndScroll ;
     static int           iFreq = FREQ_INIT ;
     static LPBYTE        pBuffer, pBuffer2 ;
     static LPWAVEHDR     pWaveHdr ;
     static PCMWAVEFORMAT pcm ;
     int                  iDummy ;
     LPBYTE               pSwap ;

     switch (message)
          {
          case WM_INITDIALOG:
               hwndScroll = GetDlgItem (hwnd, ID_SCROLL) ;
               SetScrollRange (hwndScroll, SB_CTL, FREQ_MIN, FREQ_MAX, FALSE) ;
               SetScrollPos   (hwndScroll, SB_CTL, FREQ_INIT, TRUE) ;
               SetDlgItemInt  (hwnd, ID_TEXT, FREQ_INIT, FALSE) ;

               return TRUE ;

          case WM_HSCROLL:
               switch (wParam)
                    {
                    case SB_LINEUP:    iFreq -=  1 ;  break ;
                    case SB_LINEDOWN:  iFreq +=  1 ;  break ;
                    case SB_PAGEUP:    iFreq /=  2 ;  break ;
                    case SB_PAGEDOWN:  iFreq *=  2 ;  break ;

                    case SB_THUMBTRACK:
                         iFreq = LOWORD (lParam) ;
                         break ;

                    case SB_TOP:
                         GetScrollRange (hwndScroll, SB_CTL, &iFreq, &iDummy) ;
                         break ;

                    case SB_BOTTOM:
                         GetScrollRange (hwndScroll, SB_CTL, &iDummy, &iFreq) ;
                         break ;
                    }

               iFreq = max (FREQ_MIN, min (FREQ_MAX, iFreq)) ;

               SetScrollPos (hwndScroll, SB_CTL, iFreq, TRUE) ;
               SetDlgItemInt  (hwnd, ID_TEXT, iFreq, FALSE) ;
               return TRUE ;

          case WM_COMMAND:
               switch (wParam)
                    {
                    case ID_ONOFF:

                         if (hWaveOut == NULL)
                              {
                                   // Allocate header and buffer memory

                              hWaveHdr = GlobalShareAlloc (sizeof (WAVEHDR)) ;

                              if (hWaveHdr == NULL)
                                   {
                                   MessageBeep (MB_ICONEXCLAMATION) ;
                                   MessageBox (hwnd, szMemError, szAppName,
                                               MB_ICONEXCLAMATION | MB_OK) ;
                                   return TRUE ;
                                   }
```

Figure 5: This listing contains all the C source code for the SINEWAVE program.

SINEWAVE.C 2 OF 2

```
        }

    hBuffer = GlobalShareAlloc (BUFFER_SIZE) ;

    if (hBuffer == NULL)
        {
        GlobalFree (hWaveHdr) ;
        MessageBeep (MB_ICONEXCLAMATION) ;
        MessageBox (hwnd, szMemError, szAppName,
                    MB_ICONEXCLAMATION | MB_OK) ;
        return TRUE ;
        }

    hBuffer2 = GlobalShareAlloc (BUFFER_SIZE) ;

    if (hBuffer2 == NULL)
        {
        GlobalFree (hWaveHdr) ;
        GlobalFree (hBuffer) ;
        MessageBeep (MB_ICONEXCLAMATION) ;
        MessageBox (hwnd, szMemError, szAppName,
                    MB_ICONEXCLAMATION | MB_OK) ;
        return TRUE ;
        }

    pWaveHdr = (LPWAVEHDR) GlobalLock (hWaveHdr) ;
    pBuffer  = (LPBYTE)    GlobalLock (hBuffer) ;
    pBuffer2 = (LPBYTE)    GlobalLock (hBuffer2) ;
    bShutoff = FALSE ;

            // open waveform audio for output

    pcm.wf.wFormatTag       = WAVE_FORMAT_PCM ;
    pcm.wf.nChannels        = 1 ;
    pcm.wf.nSamplesPerSec   = SAMPLE_RATE ;
    pcm.wf.nAvgBytesPerSec  = SAMPLE_RATE ;
    pcm.wf.nBlockAlign      = 1 ;
    pcm.wBitsPerSample      = 8 ;

    if (waveOutOpen (&hWaveOut, 0, &pcm.wf,
                     hwnd, 0L, CALLBACK_WINDOW))
        {
        GlobalUnlock (hWaveHdr) ;
        GlobalUnlock (hBuffer) ;
        GlobalUnlock (hBuffer2) ;
            GlobalFree (hWaveHdr) ;
            GlobalFree (hBuffer) ;
            GlobalFree (hBuffer2) ;

            hWaveOut = NULL ;
            MessageBeep (MB_ICONEXCLAMATION) ;
            MessageBox (hwnd, szOpenError, szAppName,
                        MB_ICONEXCLAMATION | MB_OK) ;
            }
        }
                // close waveform audio
    else
        {
        bShutoff = TRUE ;
        waveOutReset (hWaveOut) ;
        }
    return TRUE ;
    }
  break ;

case MM_WOM_OPEN:
    SetDlgItemText (hwnd, ID_ONOFF, "Turn off") ;

    FillBuffer (pBuffer, iFreq) ;

    pWaveHdr->lpData          = pBuffer ;
    pWaveHdr->dwBufferLength  = BUFFER_SIZE ;
    pWaveHdr->dwBytesRecorded = 0L ;
    pWaveHdr->dwUser          = 0L ;
    pWaveHdr->dwFlags         = 0L ;
    pWaveHdr->dwLoops         = 1L ;
    pWaveHdr->lpNext          = NULL ;
    pWaveHdr->reserved        = 0L ;

    waveOutPrepareHeader (hWaveOut, pWaveHdr, sizeof (WAVEHDR)) ;
    waveOutWrite (hWaveOut, pWaveHdr, sizeof (WAVEHDR)) ;

    FillBuffer (pBuffer2, iFreq) ;
    return TRUE ;

case MM_WOM_DONE:
    waveOutUnprepareHeader (hWaveOut, pWaveHdr, sizeof (WAVEHDR)) ;

    if (bShutoff)
        {
        waveOutClose (hWaveOut) ;
        return TRUE ;
        }

    pSwap    = pBuffer ;
    pBuffer  = pBuffer2 ;
    pBuffer2 = pSwap ;

    pWaveHdr->lpData          = pBuffer ;
    pWaveHdr->dwBufferLength  = BUFFER_SIZE ;
    pWaveHdr->dwBytesRecorded = 0L ;
    pWaveHdr->dwUser          = 0L ;
    pWaveHdr->dwFlags         = 0L ;
    pWaveHdr->dwLoops         = 1L ;
    pWaveHdr->lpNext          = NULL ;
    pWaveHdr->reserved        = 0L ;

    waveOutPrepareHeader (hWaveOut, pWaveHdr, sizeof (WAVEHDR)) ;
    waveOutWrite (hWaveOut, pWaveHdr, sizeof (WAVEHDR)) ;

    FillBuffer (pBuffer2, iFreq) ;
    return TRUE ;

case MM_WOM_CLOSE:
    GlobalUnlock (hWaveHdr) ;
    GlobalFree   (hWaveHdr) ;

    GlobalUnlock (hBuffer) ;
    GlobalFree   (hBuffer) ;

    GlobalUnlock (hBuffer2) ;
    GlobalFree   (hBuffer2) ;

    hWaveOut = NULL ;
    SetDlgItemText (hwnd, ID_ONOFF, "Turn On") ;

    if (bClosing)
        EndDialog (hwnd, 0) ;

    return TRUE ;

case WM_SYSCOMMAND:
    switch (wParam)
        {
        case SC_CLOSE:
            if (hWaveOut != NULL)
                {
                bShutoff = TRUE ;
                bClosing = TRUE ;

                waveOutReset (hWaveOut) ;
                }
            else
                EndDialog (hwnd, 0) ;

            return TRUE ;
        }
    break ;
  }
return FALSE ;
}
```

```
waveOutOpen (&hWaveOut, wDeviceID,
  &waveformat, dwCallBack,
  dwCallBackData, dwFlags)
```

You set the first parameter to point to a variable of type HWAVEOUT (handle to waveform audio output). This variable receives a handle used in subsequent waveform output calls. The second parameter is a device ID, a number ranging from 0 to one less than the number of waveform output devices installed in the system. Set it to 0 for the first device. The third parameter is a pointer to a WAVEFORMAT structure. (More about this later.) The fourth parameter is either a window handle or a pointer to a callback function in a dynamic link library (DLL). This parameter indicates the window or callback function that receives the waveform output messages. If you use a callback function, you can specify program-defined data in the fifth parameter. The dwFlags parameter can be set to either CALLBACK_WINDOW or CALLBACK_FUNCTION to indicate what the fourth parameter is. You can also use the flag WAVE_FORMAT_QUERY to check if the device can be opened without actually opening it.

The third parameter to waveOutOpen is defined as a pointer to a structure of type WAVEFORMAT, defined in MMSYSTEM.H as shown in Figure 9.

The only value currently defined for the first field is WAVE_FORMAT_PCM to indicate pulse code modulation. In this case, the nAvgBytesPerSec field is set to the product of the sample rate, the sample size in bytes, and the number of channels (1 for mono and 2 for stereo). Set nBlockAlign to the number of bytes per sample (that is, the sample size in bytes times the number of channels).

Now this is important: It is not suffi-

cient to initialize the fields of a WAVEFORMAT structure and pass its pointer to the waveOutOpen function. Instead, you need to use the WAVEFORMAT structure as part of a PCMWAVEFORMAT structure, shown in Figure 10.

SINEWAVE defines a structure of type PCMWAVEFORMAT like so:

```
PCMWAVEFORMAT pcm ;
```

It then initializes all the pcm.wf fields and pcm.wBitsPerSample, calling waveOutOpen like this:

```
waveOutOpen (&hWaveOut, 0,
 &pcm.wf, hwnd, 0L,
 CALLBACK_WINDOW)
```

The waveOutOpen function returns 0 if the function is successful and a nonzero error code otherwise. If waveOutOpen returns nonzero, SINEWAVE cleans up and displays a message box indicating an error.

WRITING WAVEFORM OUTPUT

When using a window procedure for receiving waveform output messages, the waveOutOpen function posts a MM_WOM_OPEN message to the program's message queue. Although SINEWAVE doesn't use it, the wParam message parameter is set to the waveform output handle.

To process the MM_WOM_OPEN message, SINEWAVE calls FillBuffer to fill the pBuffer buffer with sine wave data. It then initializes the fields of a WAVEHDR structure. The WAVEHDR structure is shown in Figure 11. SINEWAVE sets lpData to the buffer containing the data, dwBufferLength to the size of this buffer, and dwLoops to 1. All other fields can be set to 0 or NULL. If you want to play a repeated loop of sound, you can specify that with the dwFlags and dwLoops fields.

Next, SINEWAVE calls waveOutPrepareHeader. This function apparently calls GlobalPageLock for both the global memory blocks with the WAVEHDR structure and the data buffer, preventing the structure and buffer from being swapped to disk when the program runs in 386 Enhanced mode. SINEWAVE then passes the WAVEHDR structure to waveOutWrite. This is the function that actually starts the sound playing by passing the data to the waveform output hardware.

Although *Windows* is non-preemptive, some functions in Multimedia *Windows* use background processing. The waveOutWrite function is one of them. The function returns quickly and the passing of data to the waveform output hardware occurs in the background. SINEWAVE takes advantage of this background processing by calling FillBuffer again using pBuffer2. This is in preparation for sending a second buffer of data to the waveform hardware during the MM_WOM_DONE message. This "double buffering" is often necessary when working with waveform audio.

PROCESSING MM_WOM_DONE

When the waveform hardware is finished playing the data passed to it in the waveOutWrite function, the window is posted an MM_WOM_DONE message. Although SINEWAVE doesn't use the message parameters, wParam is the waveform output handle and lParam is a pointer to the WAVEHDR structure.

SINEWAVE processes the MM_WOM_DONE message by first calling the waveOutUnprepareHeader function. This function undoes waveOutPrepareHeader by calling GlobalPageUnlock for both the WAVEHDR structure and the data buffer. SINEWAVE then swaps the pBuffer and pBuffer2 pointers. MM_WOM_DONE processing proceeds identically to MM_WOM_OPEN processing: SINEWAVE sets up the fields of the WAVEHDR structure, calls waveOutPrepareHeader, and waveOutWrite, and then fills pBuffer2 by calling FillBuffer

SINEWAVE.H COMPLETE LISTING

```
/*-------------------------
   SINEWAVE.H header file
  -------------------------*/

#define ID_SCROLL   10
#define ID_TEXT     11
#define ID_ONOFF    12
```

Figure 6: This header file defines constants that are used in both SINEWAVE.C and SINEWAVE.RC.

SINEWAVE.RC COMPLETE LISTING

```
/*-----------------------------
   SINEWAVE.RC resource script
  -----------------------------*/

#include <windows.h>
#include "sinewave.h"

sineWave DIALOG 32768, 0, 200, 50
   STYLE WS_OVERLAPPED | WS_CAPTION | WS_SYSMENU | WS_MINIMIZEBOX | WS_VISIBLE
   CAPTION "Sine Wave Generator"
   {
   SCROLLBAR            ID_SCROLL,   8,   8, 150, 12, WS_GROUP | WS_TABSTOP
   RTEXT      "440"     ID_TEXT,   162,  10,  20,  8
   LTEXT      " Hz"     -1,        182,  10,  12,  8
   PUSHBUTTON "Turn On" ID_ONOFF,   80,  28,  40, 14
   }
```

Figure 7: This resource script defines the dialog box template used for the program's window.

SINEWAVE.DEF COMPLETE LISTING

```
;-------------------------------------
; SINEWAVE.DEF module definition file
;-------------------------------------

NAME            SINEWAVE

DESCRIPTION     'Sine Wave Generator (c) Charles Petzold, 1991'
EXETYPE         WINDOWS
STUB            'WINSTUB.EXE'
CODE            PRELOAD MOVEABLE DISCARDABLE
DATA            PRELOAD MOVEABLE MULTIPLE
HEAPSIZE        1024
STACKSIZE       8192
EXPORTS         DlgProc
```

Figure 8: The module definition file provides information for the linker to create SINEWAVE.EXE.

again. This process continues until the user clicks the "Turn Off" button to turn off the sine wave generator.

TURNING IT OFF

When the user clicks the "Turn Off" button in order to turn off the sound, DlgProc receives another WM_COMMAND message. For this message, DlgProc sets the bShutOff variable to TRUE and calls the waveOutReset function. WaveOutReset stops sound processing and then generates a MM_WOM_DONE message. When bShutOff is TRUE, SINEWAVE processes MM_WOM_DONE by calling waveOutClose. This in turn generates an MM_WOM_CLOSE message. Processing of MM_WOM_CLOSE mostly involves cleaning up. SINEWAVE unlocks the three memory blocks and frees them and sets the text of the button to "Turn On."

If the waveform hardware is still playing a buffer, calling waveOutClose by itself will have no effect. You must call waveOutReset first to halt the playing and generate an MM_WOM_DONE message.

DlgProc also processes the WM_SYSCOMMAND message when wParam is SC_CLOSE. This results from the user selecting Close from the system menu. If waveform audio is still playing, DlgProc calls waveOutReset. Regardless, EndDialog is eventually called to close the dialog box and end the program.

THE FASTER FILLBUFFER ROUTINE

I mentioned earlier that I wanted to avoid using floating-point calculations in the FillBuffer routine. The version of FillBuffer that is used in SINEWAVE.C uses floating point in only the very first call to calculate a sine wave lookup table used in subsequent calls. This sine wave table contains 2,048 byte values. The phase angle is a 32-bit integer treated as a 24-bit integral value and an 8-bit fractional value. The size of this lookup table and my use of it was based on guidelines suggested in the article "Table Lookup Noise for Sinusoidal Digital Oscillators" by F. Richard Moore (*Computer Music Journal*, April 1977).

If you're going to be experimenting with SINEWAVE (perhaps by trying the 22,050-Hz sampling rate), watch out for the calculation of dwAngle in the FillBuffer function. As it stands, it's 1 bit away from overflowing during high-frequency calculations.

THE WAVEFORMAT STRUCTURE — COMPLETE LISTING

```
typedef struct waveformat_tag
        {
        WORD  wFormatTag ;          // waveform format
        WORD  nChannels ;           // number of channels
        DWORD nSamplesPerSec ;      // sample rate
        DWORD nAvgBytesPerSec ;     // bytes per second
        WORD  nBlockAlign ;         // block alignment
        }
        WAVEFORMAT ;
```

Figure 9: This structure, defined in MMSYSTEM.H, is used with the waveOutOpen function.

THE PCMWAVEFORMAT STRUCTURE — COMPLETE LISTING

```
typedef struct pcmwaveformat_tag
        {
        WAVEFORMAT wf ;
        WORD  wBitsPerSample ; // bits per sample
        }
        PCMWAVEFORMAT ;
```

Figure 10: You can't initialize the fields of a WAVEFORMAT structure (shown in Figure 9) and pass its pointer to the waveOutOpen function. You need to use that structure as part of a PCMWAVEFORMAT structure, as shown above.

THE WAVEHDR STRUCTURE — COMPLETE LISTING

```
typedef struct wavehdr_tag
        {
        LPSTR lpData ;              // buffer pointer
        DWORD dwBufferLength ;      // buffer length
        DWORD dwBytesRecorded ;     // returned data length
        DWORD dwUser ;              // program-defined
        DWORD dwFlags ;             // flags
        DWORD dwLoops ;             // loop counter
        struct wavehdr_tag far *lpNext ;  // reserved
        DWORD reserved ;            // reserved
        }
        WAVEHDR ;
```

Figure 11: This structure is used for writing buffers to the waveform output hardware.

BEYOND THE SINE WAVE

Once you know how to calculate sine waves and send them out to the waveform audio hardware, in theory you know how to calculate any other periodic waveform. All you need to do is calculate multiple sine waves with frequencies that are integral multiples of the fundamental, apply scaling factors to each harmonic, and add them together. For each sine wave you generate, you need to maintain a unique phase angle. This is a problem that practically cries out for an object-oriented solution.

SINEWAVE seems to have a little problem—actually quite a big problem—and I don't know what's causing it. When I run the program using my Sound Blaster card, I hear not only the sine wave but a very distinct thumping sound occurring about five times per second. Normally I'd suspect my own code, but I get the same result when I record a sine wave from my synthesizer in the WAVEEDIT program (included in *Windows*' MDK) and then play it back.

I suspect the problem is related to discontinuities when the Sound Blaster driver feeds the data to the board, but I don't know. At the time I'm writing this column in mid-July, I'm still working with the beta version of the Multimedia Extensions that were distributed in November 1990, and I'm patiently awaiting the final release scheduled (the last I heard) for the end of July.

If the problem simply goes away in the retail release of Multimedia *Windows*, I'll be very happy. If not, well, it'll be something else in *Windows* for us to complain about! ■

by
Ray Duncan

Power Programming

Strategies for Optimizing Assembly Language Programs

■ To help your assembly language programs deliver maximum performance, sometimes you'll want to optimize for size, sometimes for speed, and sometimes you're better off leaving well enough alone.

In spite of the increasing dominance of high-level languages and integrated development environments, the optimization of assembly language code is still a fashionable subject for on-line debates. Thus the Programming Forum on PC MagNet has been the venue for many "coding challenges": one member describes a small but interesting programming problem, then sits back to see who can solve it in the fewest number of bytes. Similarly, the assembler/cpu8088 conference on BIX has been the site of many grave deliberations on obscure assembly language optimization issues.

Grass-roots interest notwithstanding, the literature on Intel 80x86 assembly language optimization is surprisingly sparse. While preparing a talk on this subject for the Software Development Conference a couple of years ago, I searched the back issues of the major programming magazines and found only a handful of articles. The literature on code optimization for high-level language compilers, on the other hand, is quite extensive, and many of the concepts developed in this literature are useful in assembly language coding as well. I've included a bibliography for those of you who wish to explore this subject further (see the sidebar "Further Reading"). In the meantime, let's survey some of the more common optimization techniques and then turn to the larger question of when and where to optimize.

OPTIMIZING FOR SPEED

When you decide that a program isn't running fast enough, the first thing to do is to make sure that you are using the best algorithms and data representations for the job. Switching from an inappropriate or primitive algorithm to one that's more fitting or clever may well speed up your program by an order of magnitude or more, so taking the time to peruse Knuth or Sedgewick for an algorithm you wouldn't be likely to think of on your own is time well invested. Similarly, changing from an "obvious" but simple data structure (such as a linked list) to a more sophisticated structure (such as a B-tree) may yield results far out of proportion to the programming effort involved.

Once you're satisfied that you're using the best algorithms and data structures, the next thing to look at is the program's use of mass storage. Even the fastest disk devices used on personal computers are abominably slow compared with the computing horsepower of an 80386 or 80486, so you'll want to minimize or eliminate disk I/O whenever possible. Become familiar with all the types of memory available to a DOS program—extended memory, expanded memory, upper memory blocks, and the high memory area—and fully exploit this memory to keep your program's data in RAM where you can get at it quickly. You may even want to look into data compression techniques, because it will almost always be faster to squeeze data and unsqueeze it again than to read it two or more times from disk.

Another important area to address is reducing your program's calculation burden. The compiler writers have fancy terms—*common subexpression elimination, constant folding, constant propagation*—for variations on the basic rule that your program should never calculate the same value twice at runtime; instead, it should calculate the value once, and save it for reuse. An even better solution is to move calculations from runtime to assembly time whenever the limited mathematical abilities of MASM (or TASM or OPTASM) allow. Along the same lines, you may be able to enhance a program's performance drastically by converting calculations to table lookups, and making use of tables that are generated and stored on-disk ahead of time by a separate program.

Once you've done whatever can be done at these more abstract levels, you're pretty much reduced to classic code hacking and cycle shaving to improve your program's performance—particularly if your program is heavily display-oriented and performs its own memory-mapped video output. Some of the more common optimizations in this category are:

- Substitution of fast special-case sequences of instructions for more generalized, complex instructions, such as replacing a hardware multiply by a power of two with a shift or series of shift instructions (strength reduction).
- Reducing the overhead of jumps and calls by converting subroutines to macros and assembling them in-line; changing the sense of conditional jumps so that the jumps are taken on the less common condition; moving common cases to the

FURTHER READING

by Ray Duncan

The following are selected readings on code optimization for assembly language programmers.

BOOKS:

- *Compilers: Principles, Techniques, and Tools*, chapter 10, by Alfred Aho, Ravi Sethi, and Jeffrey Ullman, Addison-Wesley Publishing Co., Reading, Mass., 1986.
- *Crafting a Compiler*, chapters 15 and 16, by Charles Fischer and Richard LeBlanc, Benjamin/Cummings Publishing Co. Inc., Menlo Park, Calif., 1988.
- *Programming Pearls*, chapters 3, 5, 8, and 9, by Jon Bentley, Addison-Wesley Publishing Co., Reading, Mass., 1986.
- *Writing Efficient Programs*, by Jon Bentley, Prentice Hall Publishing Co., Englewood Cliffs, N.J., 1982.
- *The Zen of Assembly Language*, by Michael Abrash, Scott Foresman & Co., Glenview, Ill., 1990.

ARTICLES:

- "Assembly Language Tricks of the Trade," by Tim Paterson, *Dr. Dobb's Journal*, March 1990, page 30.
- "Loop Unrolling," by Mark Barrenechea, *Programmer's Journal*, July/August 1991, page 66.
- "More Optimizing for Speed," by Michael Abrash, *Programmer's Journal*, July/August 1986, page 36.
- "Optimania," by Mark Barrenechea, *Programmer's Journal*, January/February 1991, page 72.
- "Optimization Strategies," by Gary Sarff, *Computer Language*, December 1985, page 27.
- "Optimizing C with Compiler-Generated Assembly," by John Ross, *Computer Language*, November 1988, page 59.
- "Optimizing Compilers," by Mark Roberts, *BYTE*, October 1987, page 165.
- "Optimizing Compilers for C," by Richard Relph, *Dr. Dobb's Journal*, August 1987, page 42.
- "Optimizing for Speed," by Michael Hoyt, *Programmer's Journal*, March/April 1986, page 32.
- "Optimizing Integer Multiplications by Constant Multipliers," by Robert Grappel, *Dr. Dobb's Journal*, March 1987, page 34.
- "Peak Performance," by Mark Barrenechea, *Programmer's Journal*, November/December 1990, page 64.
- "Pushing the Envelope," column by Michael Abrash in *PC Techniques*.
- "Roll Your Own Languages with Mini-interpreters," by Michael Abrash and Dan Illowsky, *Dr. Dobb's Journal*, September 1989, page 52.
- "Secrets of Optimization," by Walter Bright, *Micro Cornucopia*, January/February 1989, page 26.
- "8088 Assembly-Language Programming Techniques," by Tom Disque, *Dr. Dobb's Journal*, July 1987, page 24.
- "80x86 Optimization," by Michael Abrash, *Dr. Dobb's Journal*, March 1991, page 16.

front of multiway jumps; converting calls followed immediately by returns into jumps ("tail merging" and "tail recursion optimization"), and so on.

- Various loop optimizations including moving the calculations of invariant values outside of loops, simplifying calculations inside of loops, unrolling loops, and consolidating separate loops that are executed the same number of times into a single loop ("loop jamming").
- Taking maximum advantage of the available registers by keeping working values in registers whenever possible to minimize memory accesses, packing multiple values or flags into registers, and eliminating unnecessary stack pushes and pops (especially at subroutine entries and exits).
- Exploiting CPU-specific instructions such as the push immediate value instruction that is available on 80286 or later CPUs, or the doubleword string instructions, 32-bit by 32-bit multiply, 64-bit by 32-bit divide, and multiply by immediate value instructions that are available on 80386 and 80486 CPUs. Of course, your program must first determine which CPU it is running on! The routine shown in Figure 1 can help in this regard: It returns a code indicating CPU type.

On 80286 and later CPUs, you may also be able to improve execution speed by a few percent by aligning data items and the targets of jump instructions on appropriate boundaries. The 8086 and 80286 are 16-bit CPUs and like to see things aligned on 16-bit (word) boundaries; the 80386 prefers 32-bit (doubleword) alignment; and the 80486 performs best with paragraph (16-byte) alignment because of the design of its internal cache.

If all else fails and you're writing a specialized application rather than a mass-market software package, you can usually trump your performance problems with hardware. At today's mail-order prices, the cost of replacing the machine your application runs on with a new, much faster machine may be considerably less than the cost of the time required for you to painstakingly redesign, optimize, and re-debug the application. Unfortunately, the undiscriminating embrace of this strategy by vendors such as Microsoft and Lotus has brought us bloated monstrosities such as *Windows* 3.0, *Programmer's Workbench*, and *Lotus 1-2-3/G*, but that's a subject for another day.

OPTIMIZING FOR SIZE

If your program is too big to run (rather than too slow), you need to fall back on optimization strategies that are in most ways the exact inverse of the tricks you use for speed. First examine your program carefully to determine whether the primary problem is code size or data size.

If your data is too big, sophisticated data structures may help, but the elimination of fast but sparse arrays or tables in favor of more compact structures such as linked lists and the packing of data using bit fields will probably yield more short-term benefits. Brute force compression and decompression of tables or structures as they are needed is not usually very useful, because it's often necessary to

CPUTYPE.ASM — **COMPLETE LISTING**

```
        title   CPUTYPE -- Check CPU Type
        page    55,132
        .486

; CPUTYPE.ASM - Returns Intel CPU type.  Adapted from
;               source code distributed to ISVs by Intel Corp.
;
; Call with:    N/A
;
; Returns:      AX = CPU type
;                    0086H = 8086 or 8088
;                    0286H = 80286
;                    0386H = 80386SX or 80386DX
;                    0486H = 80486SX or 80486DX
;
; Destroys:     upper 16-bits of EAX and ECX on 386/486

_TEXT   segment word use16 public 'CODE'

        assume  cs:_TEXT

        public  cputype
cputype proc    near

        pushf                           ; save copy of flags and
        push    bx                      ; other affected registers
        push    cx
        pushf                           ; now try to clear bits 12-15
        pop     ax                      ; of CPU flags
        and     ax,0fffh
        push    ax                      ; set modified CPU flags
        popf
        pushf
        pop     ax                      ; get flags again
        and     ax,0f000h               ; if bits 12-15 are still
        cmp     ax,0f000h               ; set, this is 8086/88
        jne     cpu1                    ; jump, not 8086/88
        mov     ax,0086h                ; set AX = 86/88 CPU type
        jmp     cpux

cpu1:   or      ax,0f000h               ; must be 286 or later,
        push    ax                      ; now try to set bits 12-15
        popf                            ; of CPU flags
        pushf
        pop     ax                      ; if bits 12-15 can't be
        and     ax,0f000h               ; set, this is a 286
        jnz     cpu2                    ; jump, not 80286
        mov     ax,286h                 ; set AX = 286 CPU type
        jmp     cpux                    ; and exit

cpu2:   mov     bx,sp                   ; 386 or later, save SP
        and     sp,not 3                ; avoid stack alignment fault
        pushfd                          ; get value of EFLAGS
        pop     eax
        mov     ecx,eax                 ; save copy of EFLAGS
        xor     eax,40000h              ; flip AC bit in EFLAGS
        push    eax                     ; try and force EFLAGS
        popfd
        pushfd                          ; get back EFLAGS value
        pop     eax
        mov     sp,bx                   ; restore old stack pointer
        xor     eax,ecx                 ; can AC bit be changed?
        jnz     cpu3                    ; no, jump, not a 386
        mov     ax,0386h                ; set AX = 386 CPU type
        jmp     cpux                    ; and exit

cpu3:   mov     ax,0486h                ; set AX = 486 CPU type

cpux:   pop     cx                      ; restore registers
        pop     bx
        popf                            ; restore original flags
        ret                             ; return with AX = cpu type

cputype endp

_TEXT   ends

        end
```

Figure 1: When a program is running on an 80286, 80386, or 80486 CPU, there are many CPU-specific instructions that can be exploited to improve performance. First, however, the program must be able to determine the CPU type so it can adapt itself accordingly. This routine, adapted from code distributed by Intel, returns a code indicating whether the host CPU is an 8088, 8086, 80286, 80386, or 80486.

decompress all the data just to get at one item, and the compression/decompression routines themselves occupy considerable memory.

Large lookup tables and arrays may be built in a disk file and read into memory in small chunks when needed, but this can have a crushing effect on throughput if the data is randomly accessed. Lookup tables can often be completely eliminated in favor of recomputing values as they're needed. You must also search for and remove constants and variables that are never actually used by the program because they were superseded by other constants and variables during development and debugging. In any event, I'll stress again how important it is for you to learn how to access all the types of memory that may be available on a PC, and make your program flexible enough to use any and all of them.

Optimizing a program's code for size is quite a different ballgame than optimizing it for speed. First you must inspect every line of source code and eliminate all statements or procedures that are never executed or can't be reached from any point in the main line of execution (dead code). If you've got a large application that has gone through a prolonged development cycle involving several programmers, you may be quite surprised at the number of lines you can excise. Second, analyze the program again and consolidate all identical or functionally similar code sequences into subroutines that can be called from any point in the program. The more general you can make the subroutines, the more likely it is that their code can be reused. When carried to an extreme, this approach leads to a highly modular and compact program that consists mostly of calls.

> Optimizing a program's code for size is quite a different ballgame than optimizing it for speed.

At this point, if there still isn't enough memory to go around, your efforts can diverge in several different directions. You can decompose your program into relatively independent modules that can be read into memory separately as overlays. You can encode your program's functionality in tables that "drive" its execution. You can resort to threaded-code or pseudo-code techniques that represent your program's logic in considerably less memory at some cost in performance. Or you can really pull out all the technological stops and implement a custom interpreter or compiler for a "little language" that in turn serves as the virtual machine for your application. QuickBASIC, *Excel*, and *BRIEF* are everyday examples of the threaded-code, pseudo-code, and little-language strategies, respectively.

Finally, if you're writing a special-purpose application, you may be able (again) to simply trump your memory problems with hardware or software. Among the many possibilities are: upgrading to DOS 5.0 or OS/2 2.0 to make more memory available below 640K, plugging in yet another EMS board, switching to a 80386 or 80486 machine that will support more extended memory than your 8086 or 80286 machine, and/or porting your program to run on a DOS extender.

WHEN TO OPTIMIZE, WHEN TO PUNT

Code optimization in any language always requires tradeoffs, such as:

- trading speed for memory;
- trading code maintainability and readability for code performance;
- trading development time for execution time.

These tradeoffs seem straightforward, but more often they aren't as simple as they first appear. The following two instructions, either of which can be used to transfer a value from register DX into AX (with different side effects, of course) provide a classic example:

```
XCHG    AX,DX

MOV     AX,DX
```

On an Intel 8088, the MOV instruction is 2 bytes and requires 2 CPU clock cycles, while the XCHG instruction is 1 byte but requires 3 CPU clocks. So far, a clear-cut tradeoff of speed for memory. But the actual performance of the instructions is highly dependent on context, the size of the CPU's prefetch queue, the size and characteristics of system caches, and so on, while even the number of clock cycles required to execute the instructions varies from one model of Intel CPU to another. As it turns out, it's nearly impossible to predict the performance of a nontrivial sequence of instructions on an Intel processor, especially on the later CPUs such as the 80386 and 80486, which make more extensive use of pipelining; you simply have to benchmark the various possibilities in vivo and see how they perform.

Similarly, the tradeoffs of development time for execution time and code maintainability for performance are seldom as well ordered as we'd like, and the long-term impact of wrong decisions can be enormous. By far the most important thing to understand about optimization is when to do it and when to leave well enough alone; as Donald Knuth said, "Premature optimization is the root of much programming evil." Before you can even think about tuning up your program, make sure it is logically correct and complete, that you're using the right algorithm for the job, and that you've written the cleanest, most straightforward, most structured code you possibly can.

If your program meets these criteria, its size and performance will be fine most of the time, without any further attention. Merely by using assembly language you're already getting a two- or threefold speed and size advantage over the fellow using a high-level language. And many of the characteristics that make a program easy to read and maintain will also tend to make it fast—such as the avoidance of spaghetti code with many unnecessary jumps and calls (these have a severe penalty on the Intel 80x86 architecture because they dump the instruction prefetch queue) and the use of simple straightforward machine instructions rather than complex instructions.

Nevertheless, the user's perception of your program's performance should be your overriding concern. As Michael Abrash observed, "Any optimization that is perceptible to the user is an optimization worth doing." Conversely, if your program gets the word-of-mouth reputation among users of being pudgy and pokey, it's very likely to remain unappreciated: As an example, consider the fate of *ToolBook*. Consequently, your program should *appear* to be instantly responsive, even when it's occupied with time-consuming calculations or disk operations. It should keep the screen alive with progress indicators such as dials or thermometers, and allow the user to interrupt lengthy operations safely at any time if he changes his mind and decides to do something else.

> Many of the characteristics that make a program easy to read and maintain will also tend to make it fast.

If you do have to resort to the code-hacking and cycle-shaving tricks we mentioned earlier, avoid the misdirection of your time and energy. Bear in mind the natural hierarchy of time scales—register/register operations, memory operations, disk operations, and user interactions—each of which is an order of magnitude (or more) slower than its predecessor. For example, don't waste effort trying to save a few machine cycles in a routine if your program's speed is limited by its access to disk files; try to identify ways to reduce disk I/O instead. It's vital to employ profiling tools to identify the hot spots in your program and concentrate your attention in those areas. And after you make each presumptive optimization, time the results carefully and test, test, test.

In his superb book *Writing Efficient Programs* (Prentice Hall, 1982), Jon Bentley relates a horror story from Bell Labs that we should all take to heart:

"Victor Vyssotsky enhanced a FORTRAN compiler in the early 1960's under the design constraint that compilation time could not be noticeably slower. A particular routine was executed rarely (he estimated during design that it would be called in about one percent of compilations, and just once in each of those) but was very slow, so Vyssotsky spent a week squeezing every last cycle out of the routine. The modified compiler was fast enough. After two years of extensive use the compiler reported an internal error during compilation of a program. When Vyssotsky inspected the code he found that the error occurred in the prologue of the 'critical' routine, and that the routine had contained this bug for its entire production life."

Vyssotsky made three important errors: He failed to profile the program before he optimized it, so he wasted time optimizing a routine that had no impact on performance; he failed to implement the optimized routine correctly; and he failed to test the optimized routine to see if it worked according to specification.

Now it's not my intent to pick on Mr. Vyssotsky; I've made plenty of far worse blunders in my day, though—since I don't work at Bell Labs—these blunders fortunately don't get immortalized in Jon Bentley's books. But Vyssotsky's experience is a good example of how time and energy can be wasted in the holy cause of optimization, and how a failure to methodically cover all the bases of profiling and validation during optimization will usually come home to roost sooner or later.

THE IN-BOX

Please send your questions, comments, and suggestions to me at any of the following electronic mail addresses:
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by
Fran Finnegan

Windows

ELIMINATING EXCEL'S SHEET1

I liked the "sneaky *Winword* start-up trick" in the June 11, 1991, issue. At *Windows* start-up I load Clock, two 3270 emulator sessions, *Excel* and *Microsoft Word for Windows* by using the WIN.INI [Windows] load= entry. So now I use that nifty /n.doc parameter to load *Winword* without a blank Document1.

I was disappointed to learn that a similar parameter could not be used to disable *Excel* 3.0's start-up Sheet1 because, like you, I sure could use such a feature. So I've devised a method for accomplishing this trick. If you haven't already received many responses in this area, or if any other methods are more trouble than just restoring the loaded *Excel* and closing the blank Sheet1, I happily submit my solution, which works just great.

To accomplish the desired goal I used *Excel* 's ability to save a workspace as a file. Stored within workspace files (which end with the .XLW extension) along with other information are filenames of worksheets, charts, and macro sheets that are to be opened when that workspace file is opened. If no filename is listed in a workspace file when it is opened by *Excel*, no file will be opened at start-up; this prevents a blank Sheet1. But there is *no way* to save a blank workspace in *Excel*, because the File pop-up menu does *not* contain a Save Workspace command when no sheets are present!

Fortunately you can trick *Excel* by doing the following:

First, start *Excel* from within *Windows*. The default Sheet1 worksheet will be created. Second, save the workspace (just a blank Sheet1 at this point) to a file with the File Save Workspace command. In the resulting Save Workspace dialog box, get to the subdirectory where you want to store the workspace file (I place mine in the main *Excel* directory). Now type a name (I name mine EXCEL), and let the file extension default to .XLW. Choose OK and then exit *Excel*. You will have created the EXCEL.XLW workspace file, which will contain a reference to a Sheet1 worksheet. (You did not need to save Sheet1).

- ELIMINATING EXCEL'S SHEET1: How to create an "empty" workspace file to disable Sheet1 when *Excel* loads.
- DRAG AND DROP: Setting up Program Manager icons using File Manager.

Third, edit the binary EXCEL.XLW file that you just created. Since it is not a text file, you will have to use a binary file editor or utility such as Norton's NU (I use MS-DOS's DEBUG program). Change the string "Sheet1" to six space (or blank) characters, and save it. The workspace file now contains no references to any sheets!

And lastly, edit the WIN.INI file by adding EXCEL.XLW to the load= entry. If the directory where you placed it is not on your environment PATH, fully qualify the EXCEL.XLW filename with a path to it.

When you next start up *Windows*, it will load *Excel* with no start-up Sheet1. Mission accomplished!

Thanks for your great articles on *Windows*. I love 'em! I changed my button colors, too. Fun stuff!

Tom Gilmer
Bellevue, Washington

This *is* a great *Windows* trick, but there's an ever better one. The Spreadsheets column in the October 29, 1991, issue mentions an undocumented command line switch, /E, that works in Version 3.0 of *Excel*. If you have *Excel* 3.0, the /E command line argument will prevent the blank Sheet1 from appearing. Unfortunately, it doesn't work for earlier versions of *Excel*.

Mr. Gilmer's method does work in previous versions and doesn't run the risk of not being supported in later versions, as does an undocumented feature. Apparently the "blank" filename inside of EXCEL.XLW will not cause an *Excel* error. It also illustrates the procedure for editing binary files, sometimes the only way to accomplish a change you want to make.

If you don't have a binary file editor to complete the third step of Mr. Gilmer's procedure, you can use MS-DOS's DEBUG program as he noted. The following DEBUG instructions will allow you to edit the EXCEL.XLW file that was created in his second step.

Change into the subdirectory where you saved EXCEL.XLW, and make a backup copy of it for safety:

```
COPY EXCEL.XLW *.CPY
```

Read the original EXCEL.XLW into DOS's DEBUG program:

```
DEBUG EXCEL.XLW
```

Determine the size of EXCEL.XLW by typing RCX and hitting the Enter key *twice*. After doing this, your display should appear as follows:

```
-R CX
CX ####
:
-
```

where the #### value that is displayed is the hexadecimal size of your EXCEL .XLW file. On my machine, the size was 00B5.

Now using the #### value from above for your version of EXCEL.XLW, enter

```
S 100 L #### 'Sheet1'
```

to search for the string "Sheet1". Using a #### value of 00B5 as an example, your display should appear as follows:

```
-S 100 L 00B5 'Sheet1'
SSSS:0000
-
```

DEBUG has responded with the address of "Sheet1" in segment:offset form (the SSSS:OOOO shown above), the offset (OOOO) of which you will use in the following steps. On my machine, the offset portion of the address was 014B; yours may be different, depending on which version of *Excel* you have.

Display "Sheet1" to be sure you've found it, using the offset that was listed for your system (I'll use my 014B as an example here):

```
D 014B
```

You should see the word "Sheet1" on the right-hand side of the screen. Enter six blanks over "Sheet1", using the same offset as above (note that there are six blanks between the double quotes):

```
E 014B "      "
```

Display address 014B to be sure you've changed it properly:

```
D 014B
```

Six blanks (each with a hexadecimal value of 20) should have replaced "Sheet1". If you make a mistake, you can enter Q to quit DEBUG. Otherwise, enter a W to write out the modified EXCEL.XLW, and then enter a Q to quit. If everything went as planned, you can delete the EXCEL.CPY backup.

Now when *Windows* starts up, *Excel* will be loaded without a Sheet1. If you want to start up *Excel* from the Program Manager without a Sheet1, your *Excel* icon Program Item Properties Command Line should simply contain:

```
EXCEL.XLW
```

If you use my WINEXT utility (described in the June 25, 1991, issue and available on PC MagNet), the following Program Item Properties Command Line example would result in a *maximized Excel* window without any Sheet1 (you can adjust this line for your *Excel* directory requirements/preferences):

```
WINEXT.EXE + D:\ F:\EXCEL\EXCEL
EXCEL.XLW *
```

In either of these Program Manager cases, you will need to fully qualify the EXCEL .XLW filename with a path if the file is not along your environment PATH.

Another thing to be aware of is that *Excel* provides a mechanism for *automatically* loading specific files when it starts up. Any files placed in the EXCEL \XLSTART directory, and any files placed in the main EXCEL directory that have names in the form START*.XL*, are automatically loaded when *Excel* starts.

Despite the fact that you could place the EXCEL.XLW file from above in the EXCEL\XLSTART directory (or rename it STARTUP.XLW, for example, and place it in the EXCEL directory), I would *not* recommend it. If you run *Excel* a lot from the Program Manager with specific worksheets (as I do), you will end up running EXCEL.XLW needlessly if it is in the EXCEL\XLSTART directory.

Whenever you start up *Excel* with a *.XL* file, by double-clicking on it or naming it on a Program Manager command line, the blank Sheet1 worksheet is automatically disabled for you *without* the need for EXCEL.XLW. Automatically loading EXCEL.XLW, if it is in EXCEL\XLSTART, would just slow things down for you in such situations.

No matter how you use the modified EXCEL.XLW, something to be cautious of is overwriting it. You can accidentally change EXCEL.XYW by saving a new workspace over it, because *Excel* remembers that this is the name of the workspace it started up with; the File Save Workspace dialog box will contain EXCEL .XLW instead of RESUME.XLW. Unfortunately, EXCEL.XLW cannot be made a read-only file, since *Excel* would annoy you with a warning message box each time it started up. You should, however, keep a copy of your fixed-up EXCEL.XLW file that *is* read-only, so that if you ever accidentally change the file, you can recopy it from this backup copy.

DRAG AND DROP

Here's a quick and easy way to set up *Windows'* Program Manager icons using the File Manager.

Load the Program Manager and the File Manager on-screen at the same time. Use the mouse to point to the File Manager icon of the program to be set up. While holding down the left mouse button, drag the icon over to a location in a Program Manager window where you want the icon to be displayed. When you release the mouse button, the program's icon appears in the Program Manager window.

When you use this technique, the program's full pathname is carried with the icon. It works not only for programs and batch files, but for any file that has an association assigned to its extension, so you can use it to set up icons that launch specific documents, charts, spreadsheets, and so on.

Danny Stephens
Marion, Indiana

This technique is called *drag and drop*. In *Windows* 3.0 it is confined to the File Manager and Program Manager. In *Windows* 3.1 all applications are potentially *drop targets* of files, not just Program Manager. For example, you will be able to drop files onto the Print Manager for printing, provided their extensions have been registered beforehand (a concept new to *Windows* 3.1 that is similar to extension associations).

During a drag, the mouse cursor sometimes changes to the international "no" sign—a circle with a line through it. This signifies that if you drop the file(s) in the cursor's current location, by releasing the mouse button, nothing will happen.

Depending on where the mouse is at the time of the drop, the context of the drop changes. For example, dropping it onto a drive icon means to copy the file(s) to that drive. Dropping it onto a directory means to copy or move the file(s) to that directory, depending on whether the directory is located on the same drive as the file(s). And dropping it onto an executable file (a .COM, .EXE, .BAT, or .PIF file) means to run the executable file and pass it the dropped filename(s) as arguments.

OPENING WINDOWS

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by
Sal Ricciardi

Databases

DELAYS YOU CAN TRUST

If you write a *Clipper* program and need to include a delay in it, you may be tempted to use a DO WHILE loop and a countdown counter to achieve the delay. This method works well, except that it's not portable. If you run the program on a computer other than the one on which it was created, and that computer is faster, the delay code will execute more quickly and the actual time for the delay will be different from what you expected.

Another way to delay a program for a certain number of seconds is to use *Clipper*'s SECONDS() function as follows:

```
x = SECONDS() + 10
DO WHILE SECONDS() < x
ENDDO
```

This method uses the timer to delay program execution for 10 seconds. You can change the 10 in the first line to the number of seconds of delay you need. It does not, however, work across midnight.

Peter M.L. Lottrup
Buenos Aires, Argentina

PC MAGAZINE Using a program loop to create a delay isn't recommended, as such a loop will cause a shorter or longer delay on faster or slower hardware. Mr. Lottrup's technique will work well, providing your delay period doesn't cross midnight. If it does, your delay will be infinite. A technique that works across midnight is presented below. But first, some explanation is in order.

The system BIOS in every PC maintains a running count known as the *timer tick count*. This count is incremented approximately 18.2 times per second and is driven by the computer's timer-counter chip. The chip is run at a fixed frequency that causes the count to increment 18.2 times per second, regardless of the CPU speed. In other words, it doesn't matter whether it's a 4.77-MHz 8088 or a 33-MHz 80486, the count will still be incremented 18.2 times per second.

> ■ DELAYS YOU CAN TRUST: If you want your application to rest for a short time, these functions overcome the problems of other delay methods that aren't portable and don't work past midnight.

The timer tick count is stored in memory and is used by DOS as the basis for calculating the time of day. At midnight, the system BIOS resets the timer tick count to 0 and the count begins again.

Clipper's SECONDS() function converts the timer tick count into seconds to return the number of seconds elapsed since midnight. This value can range from 0 to 86399. Since the SECONDS() function depends on the timer tick count, and since the timer tick count restarts at midnight, so does the SECONDS() function. So if you call the SECONDS() function at one second before midnight, it will return 86399. If you call it at midnight, it will return 0.

Let's examine what would happen if the sample code shown above started executing 5 seconds before midnight. First, x would be set to 10 more than 86394, which represents the number of

DELAYC.ASM 1 OF 2

```
                PAGE  96,132
;*****************************************************************
; DELAYC.ASM                        Clipper UDF to delay n timer ticks
; Author..: Sal Ricciardi
;
; Use this file for program delays that are the same regardless
; of CPU type and speed.  Relies on the BIOS timer tick count.
; Maximum delay is 65535 ticks (about 1 hr).  Does not validate
; passed parameters.
;
; Usage:
;
; DELAY(10*18.2)              && for 10 seconds
;
; Create .OBJ with:   TASM delayc  (Borland Turbo Assembler 2.5) ;
; To link into your Clipper 5 app:
;   RTLINK FILE yourapp.obj, DELAYC.OBJ LIB CLIPPER, EXTEND ;
; To link into your Clipper Summer 87 app:
;   PLINK86 FILE yourapp.obj, DELAYC.OBJ LIB CLIPPER, EXTEND ;
;*****************************************************************
                .MODEL LARGE
                EXTRN __parni:FAR, __ret:FAR
                PUBLIC delay
                .CODE

Timerlow        EQU   WORD PTR ds:[046ch]

delay           PROC  FAR                          ;entry point
                push  ax                           ;save registers
                push  bx                           ;
                push  cx                           ;
                push  dx                           ;
                push  ds                           ;
                mov   ax,1                         ;routine to get a numeric
                push  ax                           ;parameter from Clipper,
                call  __parni                      ;converted to an int in
                add   sp,2                         ;ax
```

Figure 1: The assembler source code for the *Clipper* DELAY() user-defined function.

DELAYC.ASM — 2 OF 2

```
            mov     cx,ax                   ;put it in cx
            jcxz    d999                    ;skip if cx==0
            mov     ax,0040h                ;
            mov     ds,ax                   ;ds == 0040h
d010:                                       ;
            mov     ax,Timerlow             ;get timer tick count low
d020:                                       ;
            cmp     ax,Timerlow             ;watch for it to change
            je      d020                    ;keep watching until it does
            loop    d010                    ;keep looping until cx == 0
d999:                                       ;
            call    __ret                   ;post NIL return value

            pop     ds                      ;restore registers
            pop     dx                      ;
            pop     cx                      ;
            pop     bx                      ;
            pop     ax                      ;
            ret                             ;return to caller
delay       ENDP

            END
```

seconds elapsed as of 11:59:55 P.M., plus 10. The result is 86404. Then the DO WHILE loop would begin executing. Each time through the loop, SECONDS() would return a result, starting with 86394, 86395, 86396 and so on, until it reached 86399, which is 1 second before midnight. Then it would start again at 0. Since SECONDS() never returns anything greater than 86399, the loop condition SECONDS() > 86404 will never succeed, and the loop will run forever.

What's needed is a technique for accurate delays that works independently of processor speed and that correctly handles midnight. One possibility is the INKEY(n) function, which accepts an optional delay that works across midnight. Of course, INKEY() can be terminated by a keypress, so its use is restricted to situations where the delay is optional.

A better alternative is the DELAY() UDF shown in Figure 1. It will delay program operation for up to an hour, and it works independently of processor speed and across midnight. To use it in your *Clipper* programs, just pass it the number of timer ticks to delay. Since there are approximately 18.2 timer ticks per second, you can delay for 10 seconds like this:

```
delay(10 * 18.2)
```

The DELAYC.ASM source code and DELAYC.OBJ object file for linking with your *Clipper* applications are available for downloading from PC MagNet; look for the file named DELAYC.ZIP.

Since program delays are a common requirement, I have provided a .BIN version that will work in *dBASE III Plus*, *dBASE IV*, *FoxPro*, or any other *dBASE*-

DELAY.ASM — COMPLETE LISTING

```
            PAGE  96,132
;*****************************************************************
; DELAY.ASM                         .BIN file to delay n timer ticks
; Author..: Sal Ricciardi
;
; Use this file for program delays that are the same regardless
; of CPU type and speed.  Relies on the BIOS timer tick count.
; Maximum delay is 65535 ticks (about 1 hr).  Does not validate
; passed parameters.
;
; Create with:   TASM delay  (Borland Turbo Assembler 2.5)
;                TLINK delay
;                EXE2BIN delay
;                DEL DELAY.OBJ
;                DEL DELAY.MAP
;                DEL DELAY.EXE
;
; Usage:  (dBASE III Plus, FoxBASE+, dBASE IV)
;
; .LOAD DELAY
; .ticks = 10 * 18.2                  && for 10 seconds
; .CALL DELAY WITH STR(ticks)         && Don't forget the parameter
; .RELEASE DELAY
;
;*****************************************************************
            .MODEL SMALL
            .CODE

Timerlow    EQU   WORD PTR ds:[046ch]

delay       PROC  FAR                           ;entry point
            push  ax                            ;save registers
            push  cx                            ;
            push  ds                            ;
            push  es                            ;
            push  si                            ;
                                                ;
            call  asc2bin                       ;convert parameter to binary
            mov   cx,ax                         ;get ticks in cx
            jcxz  d999                          ;if cx==0, skip it
            mov   ax,0040h                      ;
            mov   ds,ax                         ;ds == 0040h
d010:                                           ;
            mov   ax,Timerlow                   ;get timer tick count low
d020:                                           ;
            cmp   ax,Timerlow                   ;watch for it to change
            je    d020                          ;keep watching until it does
            loop  d010                          ;keep looping until cx == 0
d999:                                           ;
            pop   si                            ;restore registers
            pop   es                            ;
            pop   ds                            ;
            pop   cx                            ;
            pop   ax                            ;
            ret                                 ;return to caller
delay       ENDP
;-----------------------------------------------------------------
; asc2bin     Convert ascii decimal string to 16-bit unsigned binary ;
; Entry:  DS:BX --> ascii string
; Exit:   AX = 16-bit number
;
; Ignores leading blanks, then conversion stops at null or first
; non numeric.
;-----------------------------------------------------------------
asc2bin     PROC
            push  bx                            ;Save bx and dx
            push  dx                            ;
            mov   si,bx                         ;Get offset in si
            xor   ax,ax                         ;Clear ax
            xor   bx,bx                         ;and bx
            xor   dx,dx                         ;and dx
a00001:                                         ;
            cmp   BYTE PTR ds:[si],' '          ;q. leading blanks?
            jne   a00010                        ;a. no.. move on
            inc   si                            ;a. yes.. ignore leading blanks
            jmp   a00001                        ;(so we can use STR() function)
                                                ;
a00010:     lodsb                               ;Get next ascii byte
            or    al,al                         ;q. is it zero?
            jz    a00090                        ;a. yes .. finished
            cmp   al,'9'                        ;q. is > 9?
            ja    a00090                        ;a. yes .. finished
            cmp   al,'0'                        ;q. is it < 0?
            jb    a00090                        ;a. yes .. finished
a00020:                                         ;Multiply current answer by 10
            mov   dx,bx                         ;Save in dx
            shl   bx,1                          ;* 2
            shl   bx,1                          ;* 4
            add   bx,dx                         ;* 5
            shl   bx,1                          ;* 10
            and   ax,0fh                        ;Mask off ascii
            add   bx,ax                         ;Add to result
            jmp   a00010                        ;go get next byte
a00090:                                         ;
            mov   ax,bx                         ;Put result in ax
            pop   dx                            ;Restore registers
            pop   bx                            ;
            ret                                 ;return to caller
asc2bin     ENDP
            END   delay
```

Figure 2: The assembler source code for the DELAY.BIN file.

compatible implementation that supports the *dBASE III Plus* LOAD and CALL interface conventions.

The assembly listing to create the .BIN file is shown in Figure 2. It differs from the *Clipper* version in that it requires you to pass it a character string instead of a numeric value for the number of timer ticks. You can use the STR() function to convert the value, as follows:

```
.LOAD DELAY
.ticks = 10 * 18.2
.CALL DELAY WITH STR(ticks)
.RELEASE DELAY
```

The DELAY function works by watching the timer tick count and waiting for it to change. Since it relies only on the timer tick count changing, and not on the count reaching any particular value, it works across midnight without a hitch.

This technique doesn't work well when run under a multitasker like Quarterdeck Office Systems' *DESQview* or *Microsoft Windows*, however. In such environments, the multitasker allocates system time to programs in units called *time slices*. This means that the delay routine would see the timer tick change *only* during *its* time slices, and would most likely miss some timer tick changes, especially if you switch to another task.

> The DELAY function works by watching the timer tick count and waiting for it to change.

Versions of the delay routine that work better in such environments can be found on PC MagNet. (The *Clipper* version is in a file named DELMC.ZIP and the .BIN version is in a file called DELM.ZIP.) These routines work by calculating the target time and then checking to see whether that time has passed. Since they rely on a calculation, they will better detect "missed" ticks that occur when another task has control.

The delay routines presented in this installment of Databases are best used where exact precision isn't required. Routines like animated opening screens displaying a product name are a good example. For accurate, high-precision timing, especially in a multitasking environment, a more complex method would be required; it would have to work at an even lower level, intercepting hardware timer interrupts or possibly programming the PC's timer chip directly.

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by
Craig Stinson

Spreadsheets

AUTOMATED PRINTING WITH ALLWAYS

In my work, I use *Lotus 1-2-3*, Release 2.2, and *Allways* to print specially designed laboratory test-data forms. Each form may generate up to six pages of output, with each page having distinct formatting characteristics.

Because my forms take a long time to print and because I share a networked LaserJet with other workers, I wrote the macro listed in Figure 1. This macro gets formatting and layout information for *Allways* to use, then retrieves and prints a series of files, one at a time.

At the end of each day I move all the worksheets to be printed (typically 60 or more) into a separate subdirectory and invoke the macro. When I come to work the following day, all the forms are waiting in the printer's output tray.

As listed in Figure 1, the macro accommodates up to 100 files. Each file consists of two pages, one printed in portrait mode, the other in landscape mode. Simple modifications would allow the macro to handle more files and more pages.

Lawrence B. Owen
Salt Lake City, Utah

- AUTOMATED PRINTING WITH ALLWAYS: A *1-2-3* macro that makes a list of files to be printed, invokes *Allways*, and prints the files in succession. Two offshoots of it incorporate different formatting for each file and specify a time for the macro to start working.
- ADDRESSES IN LIBRARY MACROS: How *Quattro Pro* library macros know whether cell and range addresses pertain to the library file or to the worksheet the macro is acting upon.

The "spreadsheet publishing add-ins," such as *Allways* and *Impress* (and Lotus's own *WYSIWYG*), produce gorgeous output, but they also add considerable time to the printing process. Generally speaking, the fancier the printout, the longer it ties up the printer.

The most recent versions of *1-2-3* for DOS (Release 2.3 and Release 3.1 or later) offer background printing, and users of earlier versions can print in the background with the help of spooling programs (such as Funk Software's *P.D.Queue* add-in). But while background printing may be a boon, allowing you to work on one worksheet while printing another, it won't appease your coworkers if your worksheets are generating rush-hour traffic on a shared printer. Mr. Owen's macro addresses this issue by doing *delayed* printing instead of background printing.

The macro is designed to handle a set of worksheets that share common formatting characteristics and have identical print ranges. But with a little effort, it can be modified to handle any printing situation involving *Allways* and either Release 2.2 or Release 2.3. Because the macro uses the /File Admin Table command, it won't work in Release 2.01.

Let's look first at how Mr. Owen's macro works in the form in which he submitted it. Then we'll see how to modify it for dissimilar worksheets. Finally, we'll add a line of code to make the macro do its thing at a preset hour of the night.

Mr. Owen has located his macro in cells L6..N28. This allows him to store the data he'll be printing in the upper-left corner of the worksheet. If the data you want to print may occupy a region larger than A1..K100, be sure to position your macro farther to the right; otherwise, the data to be printed will overwrite the macro instructions. The macro also uses the region S5..S105 to store filenames. Here, too, you'll need to make some changes if the worksheets you want to print are likely to encroach upon this range.

Don't forget that before you run any of these macros, you must attach *Allways*. It would be a shame to leave the office thinking you're getting a large print job done, only to arrive disappointed because of this minor oversight.

The macro begins by setting the default data directory to D:\SCRATCH. This is the directory into which Mr. Owen copies all the worksheets he wants to print. Change the instruction in M6 to reflect the name of the directory you'll be using.

The next four lines home the cellpointer, clear out the file-table area (S5..S105), clear out the upper-left corner of the worksheet (A1..K100), then use /FATW to create a new file table. Much like the DOS command DIR *.WK1, /FATW builds a four-column table consisting of filename, modification date, modification time, and file size. Mr. Owen's macro will use information from the first column to collect the data he needs to print.

The instructions in M11..M13 invoke *Allways*, import a format file named TABLES.ALL, and then return to *1-2-3*. Mr. Owen applies the formatting information stored in TABLES.ALL to all the worksheets he prints each night. If your situation is similar to his—that is, if you're going to be printing a set of identically formatted worksheets—then all you need to do is make a substitution in M12. Replace TABLES.ALL with the name of an .ALL file that can serve as a formatting model for the worksheets you want to print.

The {if} command in M14 checks to see that the filename table at S5 begins with a valid filename. If the data directory set in M6 has no worksheet files, the macro quits.

Cell M15 uses /Copy to store the name

ALLPR.WK1 COMPLETE LISTING

	L	M	N
6	\R	/fdD:\SCRATCH~	Set data directory
7		{home}	Put cellpointer at A1
8		/reS5..S185~	Erase table area
9		/reA1..X100~	Erase previous file
10		/fatw~S5~	Create file table
11		/aiALLWAYS~	Invoke Allways
12		/aiTABLES.ALL~	Import format file
13		{esc}	Return to 1-2-3
14	GETFILE	{if @CELL("type",S5)="b"}{quit}	Quit if all files printed
15		/cS5~FILENAME~	Get next filename
16		/fcce	Combine next file
17	FILENAME		
18		~	
19		/aiALLWAYS~	Invoke Allways
20		/llrTABLE1.ALS~Q	Retrieve layout file
21		/prcrsA1..G38~oopq	Set range, set portrait mode
22		/pg	Print page 1
23		/llrTABLE2.ALS~q	Retrieve next layout
24		/prcrsA45..H68~colq	Set range, set landscape mode
25		/pg	Print page 2
26		{esc}	Return to 1-2-3
27		/mS6..S185~S5~	Move file list up...
28		{branch GETFILE}	...and repeat

Figure 1: ALLPR creates a list of the files in the \SCRATCH directory and prints them using *Allways*. It prints two differently formatted ranges of each file, one in portrait and one in landscape orientation.

of the first file in the data directory into cell M17 (which has been given the range name FILENAME). This name is then supplied as an argument to the /File Combine command in M16. The net effect is to bring a copy of the file named in FILENAME into the upper-left corner of the worksheet on which the macro is stored.

In M19, we return to *Allways*. M20 uses *Allways'* /Layout Library Retrieve command to fetch information stored in an *Allways* "setup" (.ALS) file. This file—named TABLE1.ALS—tells *Allways* what margins Mr. Owen's worksheets will use, how long the page is, whether he'll be applying titles or borders to his printouts, and so on. If you're using this version of the macro, be sure to change the instruction in M20 to specify the name of your .ALS file.

M21 and M22 set a print range, issue an orientation command, and send page one to the printer. Then the instructions in M23..M25 load a new .ALS file, specify a new print range, switch the orientation to landscape, and print page two. At this point, the macro returns to *1-2-3*, bumps the file table up one row (moving the second file into the first position), and returns control to M14, whereupon the whole process begins anew. If the file just printed happens to be the last one in the table, the {if} command in M14 returns true, and Mr. Owen's macro can retire for the night.

You might suppose that to print dissimilar files, all you would need to do is make sure each was formatted appropriately in *Allways*, then eliminate the macro instructions in M12, M20, and M23. Unfortunately, this doesn't work. When you use /FCCE to combine one worksheet with another, any formatting instructions or print settings you may have applied to the incoming worksheet via *Allways* are lost. Therefore, to make Mr. Owen's macro work with dissimilar worksheets, we have to find a way to restore this formatting information.

Figure 2 shows one way to do it. In this version, the single range name FILENAME has been replaced by two names—WK1FILE and ALLFILE. The first, WK1FILE, gets the name of the worksheet to be printed, exactly as FILENAME did in Figure 1. The second, ALLFILE, will store the name of the worksheet's associated .ALL file. This is the file in which *Allways* stores your formatting information whenever you use the /File Save command after applying *Allways* formatting. The instruction in M13 examines the contents of WK1FILE and uses @left and @find to construct the name of the .ALL file.

Figure 2 also includes two other range names, PRTRANGE and ORIENTATION. As the names suggest, the values of these cells will tell *Allways* what range of data you want to print and whether you want it in portrait or landscape orientation. Unfortunately, you need to supply this information to the macro yourself by entering labels in A1 and A2 of each worksheet. If you want to print C10..H40 in portrait orientation, for example, enter the label C10..H40 in A1 and the label P in A2. The instructions in M14 and M15 copy A1 and A2 to the cells named PRTRANGE and ORIENTATION, respectively.

This is, admittedly, a kludgy way to get the job done; suggestions for improvement are welcome! (If your worksheets typically have data in A1..A2 already, you can change M14 and M15 to

ALLPR2.WK1 COMPLETE LISTING

	L	M	N
6	\R	/fdD:\SCRATCH~	Set data directory
7		{home}	Put cellpointer at A1
8		/reS5..S185~	Erase table area
9		/reA1..X100~	Erase previous file
10		/fatw~S5~	Create file table
11	GETFILE	{if @CELL("type",S5)="b"}{quit}	Quit if all files printed
12		/cS5~WK1FILE~	Get next filename
13		{let ALLFILE,@left(WK1FILE, @find(".",WK1FILE,0))&".ALL"}	Build ALLFILE entry
14		/cA1~PRTRANGE~	
15		/cA2~ORIENTATION~	
16		/fcce	Combine next file
17	WK1FILE		
18		~	
19		/aiALLWAYS~	Invoke Allways
20		/si	Retrieve layout file
21	ALLFILE		
22		~	
23		/prcrs	Set range
24	PRTRANGE		
25		~co	Set orientation
26	ORIENTATION		
27		q	
28		/pg	Print page 1
29		/mS6..S185~S5~	Move file list up...
30		{branch GETFILE}	...and repeat

Figure 2: This modification of Figure 1 lets you specify a different formatting file and orientation (portrait or landscape) for each file in the list of those to be printed.

point to some other pair of cells.)

The rest of the macro works essentially the same way as Figure 1 does. Cells M16..M18 combine the worksheet to be printed with the worksheet containing the macro. Cells M19..M21 invoke *Allways* and import the .ALL file. M23..M28 issue the appropriate print range and orientation commands and then send the data on its way.

What if you want your worksheets printed at, say, two in the morning instead of at five past five (or whenever you walk out the door)? That modification is truly simple. Just add the following as the first line of your macro:

```
{if @hour(@now)<>2}{branch \R}
```

Your macro will run nothing but this first line until the appointed hour arrives, at which time execution will fall through to the second line and your printer will awaken.

ADDRESSES IN LIBRARY MACROS

I recently downloaded the macro QCASE.WK1 from Library 12 of the Utilities/Tips forum on PC MagNet. I changed the /RNC and /RND commands to /ENC and /END, respectively, so that I could run the macro in *Quattro Pro* under its native menu tree. Everything works fine now, provided I store the macro on the worksheet where I need to use it. If I try to run it from a macro library, however, I get the following error message:

```
Invalid number or expression:
 {FOR} {[QCASE]B3}
```

What does this mean, and how do I correct it?

Steve Salem
Bayside, New York

It means that *Quattro Pro* can't evaluate one of the arguments of the {FOR} command in cell B3 of the file QCASE.WQ1 (or QCASE.WK1, if you've kept the worksheet in the *Lotus 1-2-3* data format). It's unable to do so, because it's looking for a range named RANGE on QCASE (the library worksheet) when, in fact, that range lies on the current worksheet—the one from which you're executing the macro.

Each time *Quattro Pro* encounters an address (a range name, a set of range coordinates, or a cell coordinate) in a library macro, it has to decide whether that address applies to the current worksheet or the library sheet. The way the program makes this determination is straightforward. If the address lies between a pair of braces, it pertains to the library worksheet. Otherwise, it pertains to the current worksheet. Thus, for example, {GOTO}RANGENAME sends the cell pointer to RANGENAME on the current worksheet, but {BRANCH RANGENAME} transfers macro execution to a cell named RANGENAME on the library worksheet.

Cells B2 and B3 of the QCASE macro read

```
/encRANGE~{?}~
{FOR COUNT1,Ø,@COLS(RANGE)-
 1,1,LOOP1}
```

The first reference to RANGE occurs in the context of an /Edit Names Create command and does not lie between braces. The second reference appears within the braces of a {FOR} command, so *Quattro Pro* assumes the first RANGE refers to the current worksheet and the second to the library worksheet. This makes for a problem!

To solve the problem, change the statement in B3 to

```
{For COUNT1,Ø,@COLS([]RANGE)-
 1,1,LOOP1}
```

The empty pair of brackets before RANGE tells *Quattro Pro* that in this case we're referring to a location on the current worksheet, not the library sheet.

To make QCASE work in a *Quattro Pro* library, you need to add empty brackets to five statements: B3, B6, B8, B9, and B11. The modified macro is listed in Figure 3.

QCASE is a handy item to have around, incidentally. It lets you change the capitalization style of all labels within a specified range. You can choose upper, lower, or "proper" case. The last option capitalizes the first letter of each word in each label. *1-2-3* users who want to take advantage of this macro can find a complete listing, along with a description of the macro's operation, in the December 12, 1989, installment of Spreadsheet Clinic (the forerunner of this column). You may also download it from Library 12 of the PC MagNet Utilities/Tips forum.

QCASE.WQ1 — COMPLETE LISTING

```
     A          B                          C                          D
1    \E         {MenuCall CHOICES}
2    .          /encRANGE~{?}~
3               {For COUNT1,Ø,@COLS([]RANGE)-1,1,LOOP1}
4               /endRANGE~{WindowsOn}{PanelOn}
5
6    LOOP1      {For COUNT2,Ø,@ROWS([]RANGE)-1,1,LOOP2}
7
8    LOOP2      {Let CURRCELL,@IF(@CELL("col",[]RANGE)+COUNT1
                <27,"",@CHAR(@INT((@CELL("col",[]RANGE)+COUNT1-1)/26)
                +64))&@CHAR(@MOD(@CELL("col",[]RANGE)+COUNT1-1,26)
                +65)&@STRING(@CELL("row",[]RANGE)+COUNT2,Ø)}
9               {If @CELL("type",@@(+"!{]"&CURRCELL))<>"l"}{Return}
10              {Recalc NEXT}
11   NEXT       +"{Let []"&CURRCELL&",@"&FUNCTION&"([]"&CURRCELL&")}"
12
13   CHOICES          Upper                      Lower                      Proper
14              Change labels to           Change labels to           Change labels to
                upper-case form            lower-case form            "proper" form
15              {Let FUNCTION,"UPPER"}     {Let FUNCTION,"LOWER"}     {Let FUNCTION,"PROPER"}
16
17   FUNCTION
18   CURRCELL
19
20   COUNT1
21   COUNT2
```

Figure 3: A version of QCASE.WK1 that will work from a *Quattro Pro* macro library. This macro changes the case of cell labels to all uppercase, all lowercase, or initial capitalization.

HINTS, TIPS, QUESTIONS

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CIRCLE 329 ON READER SERVICE CARD

by
Costa Rodis

The Working Word

PRINTING ALTERNATE PAGES

Most printers do not have a built-in feature that allows you to print on both sides of a piece of paper. Yet if you need two-sided documents, it becomes tedious to print a document flipping pages as you go. *WordPerfect* has a nice feature that allows you to print alternate pages of a document. *Microsoft Word for Windows* has no such option, but I've created a macro that does the job.

To use the PrintAltPages macro, shown in Figure 1, run it from the Macro menu, from an assigned key combination of your choice, or from the File menu as a standard option. Once the macro is run, the familiar Print File dialog pops up on the screen. Enter your options as you would normally, with the following exception. For your beginning page, enter an odd number to print only odd numbered pages or an even number to print only even numbered pages.

For example, a starting page of 1 prints odd numbered pages starting from 1, while a starting page of 4 prints only even numbered pages starting with page 4. Just print the odd pages first, flip the paper over, run the macro again and print the even pages.

The PrintAltPages macro relies on a built-in Dialog Record in the program. Using the predefined Dialog record `FilePrint` allows input of all print options. The trick to this macro lies in modifying the `.From` and `.To` fields to print only alternate page numbers. This is fairly easy with the WordBASIC macro language, which allows you to use the `.From` and `.To` fields in a simple For...Next loop.

The `Step 2` command determines the alternate page numbers. The next step, (`pg$ = Str$(curpage)`) converts `curpage`, the counter variable, into a string form, which the FilePrint subroutine requires so that it can retrieve current values. The FilePrint macro subroutine performs the actual task of sending the page to the print manager. Note that each page is printed one at a time, so a look at the print manager may show a number of jobs queued for printing.

Calvin R. Jang
Vancouver, British Columbia
Canada

- **PRINTING ALTERNATE PAGES:** Here's a macro that lets you print two-sided documents in *Winword*.
- **POP UP THE TIME IN WINWORD:** This simple five-line macro creates a clock you can pop-up with a hotkey or via a menu.

I really like the straightforward nature of this convenient macro; other schemes I've looked at for even/odd printing have a fairly rococo look and feel to them. One scheme went to the extreme of copying all odd pages to a different document window and all even pages to yet another document window before prompting the user to print either the odd pages document or the even pages document. With any lengthy document you could take a lunch break before printing was actually possible. Jang's macro is refreshing because it avoids needlessly convoluted code or a quirky approach and sticks to the simple task of printing every other page. Printing one page at a time may be a little slower than an entire string of pages at once, but the time difference is not much to pay for something that works well using an interface you already know quite well.

PRINTALTPAGES — COMPLETE LISTING

```
'PrintAltPages:  Macro to print alternate pages of a document

Sub Main

On Error Goto Quit
'Trap errors and cancel print

Dim dlg As FilePrint
'Use record structure FilePrint
GetCurValues dlg
'Retrieve current document values
Dialog dlg
'Get values as defined

For curpage = Val(dlg.From) To Val(dlg.To) Step 2
'Determine alternate pages beginning with page specified

          pg$ = Str$(curpage)
'Page number to pass to FilePrint;
'Send each page off to printer or queue

          FilePrint dlg.Type, dlg.NumCopies, dlg.Range, \
          pg$, pg$, dlg.Reverse, dlg.Draft, dlg.UpdateFields, \
          dlg.PaperFeed, dlg.Summary, dlg.Annotations, \
          dlg.ShowHidden, dlg.ShowCodes, dlg.FileName
'Access all typical print options inprint dialog box

Next
'Go to next page to print

Quit: End Sub
```

Figure 1: PrintAltPages lets you print alternating pages in *Word for Windows*.

POP UP THE TIME IN WINWORD

In the May 14, 1991, issue I saw a *WordPerfect* macro for displaying the current time. I was intrigued and found that there were instances when I needed such a thing during a hard day of writing in *Word for Windows*.

The macro I developed, Clock (Figure 2), displays a dialog box with an OK button as shown in Figure 3. The time is displayed until you either hit Enter or click on OK with the mouse. I've assigned the macro to the Ctrl-Shift-C key combination. It can also be assigned to your menu. Don't forget to make sure this macro is global if you want to use it from all of your templates.

Theodore C. Moore, Jr.
Universal City, Texas

This macro is far simpler than the macro TIME.WPM that inspired it. What can be more efficient than five lines of code to accomplish a common useful task? The first and last lines (Sub MAIN and End Sub) are necessary for all *Word for Windows* macros. The text between these lines establishes the action of the macro and how the time will be displayed. A$ = Time$() provides the current time in the format set in your WIN.INI file. (You can change the way time is displayed in your *Windows* 3.0 programs by changing the International Date Format in the *Windows* Control Panel.) The next line of the macro displays the text string "The current time is" and adds the current time (+ A$) called up by the previous line. The fourth line—MsgBox B$, "Tick Tock", 0—places the entire construction created by the previous two lines into a message box entitled Tick Tock. Of course, you can replace the title with any of your choice.

CLOCK — COMPLETE LISTING

```
Sub MAIN
A$ = Time$()
B$ = "The current time is " + A$
MsgBox B$, "Tick Tock",0
End Sub
```

Figure 2: A *Winword* macro that creates a clock in a message box.

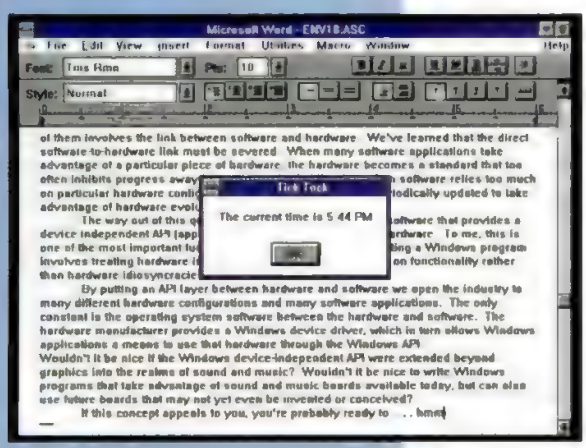

Figure 3: This pop-up clock was created by a five-line *Winword* macro.

The number that ends a MsgBox command controls what buttons and icons are displayed in the message box. In this case, the zero (0) provides only an OK button. If you want to include the Attention icon (a large exclamation point in a yellow circle to the left of the message) with the OK button, replace the 0 with 48. The arguments for other buttons and icons are shown in Figure 4. Add the value of the kind of button you are using to the type of icon you're incorporating with it to get the message box argument. For example, to create a message box that includes Yes, No, and Cancel buttons as well as the Question icon, add 3 and 32 for the result of 35. The message box statement should look like this one, substituting Test with the title of your choice:

```
MsgBox A$, "Test",35.
```

MSGBOX VALUES FOR BUTTONS AND ICONS

Buttons		Icons	
Button	Value	Icon	Value
OK	0	None	0
OK, Cancel	1	Stop	16
Abort, Retry, Ignore	2	Question	32
Yes, No, Cancel	3	Attention	48
Yes, No	4	Information	64
Cancel, Retry	5		

Figure 4: These values determine how a message box created by a *Winword* macro will look.

To assign a macro to a hotkey, as Mr. Moore suggests, is not difficult. Choose Macro, Assign To Key (Alt-M, K) and select Clock from the list. Hit the function or Ctrl key combination you want to assign to the macro. If that key combination has already been assigned to another macro, that macro's name will appear below the key combination in the Key box. Otherwise, [currently unassigned] appears below the key combination. Select Assign (Alt-A) and the hotkey will move to the left-hand box. Now, click OK or hit Enter, and whenever you press your chosen key combination, the macro will immediately run.

To add the macro to a pull-down menu is just as easy. Choose Macro, Assign to Menu (Alt-M, M) and select the macro from the Assign Macro Name list. Select the menu you want the macro to be added to from the Menu list. If the name of the macro is exactly how you want it to appear on the menu, then click OK or hit Enter. Otherwise, type in the name as you want it to read on the menu in the Menu Text box before tapping Enter or selecting OK. Now you can access the macro from a pull-down menu as well as with a key combination or from the Macro, Run menu.

TIPS FROM WORKING WORDSMITHS

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by
Neil J. Rubenking

User-to-User

AN EASY COMMAND-HISTORY UTILITY

How would you like to be able to find out what command you issued ten steps ago? Or to recall old commands without having to retype them? The following simple system lets you do just that.

There are four small batch files in the system: S.BAT to save (Figure 1), R.BAT to retrieve (Figure 2), D.BAT to delete (Figure 3), and E.BAT to edit (Figure 4). You have to put these batch files in the directory D:\UTIL and then set the PATH in your AUTOEXEC.BAT file to point to that directory.

To save any DOS commands, all you have to do is type S<space> before those commands. The commands will be executed as normal DOS commands. So if you type S TYPE AUTOEXEC.BAT | MORE the command will be saved into the command file D:\UTIL\BUFFER, and then executed.

All the commands are saved to the BUFFER file. To see them, type R without any parameters. This causes R.BAT to try to FIND some unlikely-to-occur strings in BUFFER. The /N and /V qualifiers used with FIND cause the lines that do *not* match the search string to be displayed along with their line numbers. The most recently saved command will be number 1; line numbers will increase for older commands.

Thus to recall the tenth command, you would type R 10. The entire BUFFER file is copied to a temporary file (D:\UTIL\TMP.BAT) that is then edited automatically (with EDLIN) so that only the tenth command is retained. Here's how it works.

The statement

```
ECHO %1,%1,1C;2,1000D;E | EDLIN
 d:\util\tmp.bat
```

first causes line 10—the tenth command—to be copied to the beginning of TMP.BAT (each %1 in the statement is replaced by a 10), and then deletes anything

AN EASY COMMAND-HISTORY UTILITY: Store and retrieve DOS commands with this set of four simple batch files.

from line 2 on. Note that "1000" is just some arbitrary large number used to make sure that only the first line is kept after exiting from EDLIN. Now TMP.BAT (containing only the selected command) will be executed.

You use D.BAT when your command file gets too big or you just want to delete some commands you don't need any more. As the batch file is written, if you type D without any parameter, you invoke EDLIN, which deletes all commands from line 21 on by default, saving the first 20 commands. You can, of course, change this. If, for instance, you want 30 commands to be saved, simply change 21 to 31 in the following line

```
ECHO 21,100D;E | EDLIN
 d:\util\buffer
```

When you want to delete a specific command, type R first to determine its line number, then type D *x* where *x* is the line number of the command.

The > NUL in all ECHO ... | EDLIN ... statements suppresses the display of the EDLIN command line contents.

The last batch file, E.BAT, allows you to edit the most recent command you've saved or recalled before executing it, again using EDLIN. Type E from DOS, enter 1 to display the command and after modifying it, type E to exit EDLIN. The new command will be executed.

The advantage of this system is that it is simple to create and maintain. It requires no fancy programming languages or utilities other than EDLIN, which comes with DOS.

Aaron Ho
Ontario, Canada

PC MAGAZINE This set of four simple batch files manages to duplicate many of the functions found in the popular command-history recall utilities like CED, DOSEDIT, or DOS 5.0's DOSKEY. In a sense, it's more selective; it saves only the commands you *tell* it to save. It isn't a RAM-gobbling TSR, and the history list survives even when you shut off the computer. Note that you must either keep all of the batch files in the directory D:\UTIL or edit them to reflect the directory you put them in.

There's one major problem with the

S.BAT — **COMPLETE LISTING**

```
ECHO OFF
REM                    S.BAT
REM Type "s " before any DOS command if you want
REM to save it in the command buffer file.  DOS
REM commands with over 8 replaceable parameters
REM cannot be properly executed.
REM
ECHO %1 %2 %3 %4 %5 %6 %7 %8 %9 > d:\util\tmp.bat
REM Next line replaces "{" with "<", "}" with ">",
REM   and ":" with "|".
EDLIN D:\UTIL\TMP.BAT < D:\UTIL\EDFIX.SCR > NUL
COPY d:\util\tmp.bat+d:\util\buffer d:\util\tmp1.bat > NUL
TYPE d:\util\tmp1.bat > d:\util\buffer
d:\util\tmp
```

Figure 1: S.BAT saves and executes any command line you pass to it.

R.BAT COMPLETE LISTING

```
ECHO OFF
REM                R.BAT
REM If you do not use a replaceable parameter, then
REM all the commands in the command buffer file will
REM be displayed.  Notice that there will be a number
REM displayed next to each command.  To invoke the
REM command number 10, just type "R 10" from DOS.
REM
IF "%1" == "" FIND /N /V "^^^^" d:\util\buffer
IF "%1" == "" GOTO end
COPY d:\util\buffer d:\util\tmp.bat > NUL
ECHO %1,%1,1c;2,1000D;E | EDLIN d:\util\tmp.bat > NUL
d:\util\tmp
:end
```

Figure 2: R.BAT recalls the list of saved commands and lets you reexecute any one you want without having to retype it.

D.BAT COMPLETE LISTING

```
ECHO OFF
REM                D.BAT
REM If you want to delete a particular command,
REM enter the command number as a replaceable
REM parameter.  If you do not have a replaceable
REM parameter, then if you have over 20 commands
REM in the command buffer, only the 20 most-recent
REM ones will be kept.
REM
IF "%1" == "" GOTO purge
ECHO %1,%1D;E | EDLIN d:\util\buffer > NUL
GOTO end
:purge
ECHO 21,1000D;E | EDLIN d:\util\buffer > NUL
:end
d:\util\r
```

Figure 3: D.BAT deletes any individual command you've saved, or purges all but the 20 most recent commands.

E.BAT COMPLETE LISTING

```
ECHO OFF
REM                E.BAT
REM  Type "E" from DOS to edit:
REM    1. the most recent command that you
REM       have saved using "S " from DOS
REM    2. any command that you have recalled
REM       by using "R #" from DOS.
REM  Remember that you are in EDLIN.  After you
REM  are done with editing, type "E" and your
REM  edited command will be executed.
REM
EDLIN d:\util\tmp.bat
COPY d:\util\tmp.bat+d:\util\buffer d:\util\tmp1.bat > NUL
TYPE d:\util\tmp1.bat > d:\util\buffer
d:\util\tmp
```

Figure 4: Run E.BAT to edit the most recently saved command.

system as submitted. Contrary to the author's example,

```
S TYPE AUTOEXEC.BAT | MORE
```

you can't use redirection symbols in commands to be recalled. Neither the redirection symbol nor the file or device to which it refers will be saved. In the case above, the saved command will be simply `TYPE AUTOEXEC.BAT`. However, since we're already using EDLIN, we can use it to solve this problem as well.

The following file, EDFIX.SCR, is a script to use with EDLIN:

```
1R{^Z<
1R!^Z|
1R}^Z>
E
```

The file contains commands to perform three search-and-replace operations. They replace the left curly bracket ({) with the input redirection symbol (<), the right curly bracket (}) with the output redirection symbol (>), and the exclamation point (!) with the pipe symbol (|). Note that the ^Z characters in the script indicate a Ctrl-Z. If you're willing to give up using the command-recall system with the rare files or commands that contain one of the three symbols {, }, or !, you can use the modified S.BAT. For example, the command

```
S MORE { NUL ! DATE } TEMP.BAT
```

will actually store and execute the line

```
MORE < NUL | DATE > TEMP.BAT.
```

When using R.BAT, be very careful to specify an *existing* line. If you have 10 lines saved and you enter the command `R 11`, you'll effectively hang your system. EDLIN naturally rejects the nonexistent line number, but in doing so it also rejects the *rest* of the redirected command line, including the command to exit. You can't type the Exit command yourself, because EDLIN's input has been redirected. The only solution is to reboot.

There is a hidden advantage to using this set of batch files to execute commands. You can include environment strings in the commands you save with S.BAT. For example, `S ECHO %PATH%` will echo your current path to the screen. If you just typed `ECHO %PATH%` at the DOS prompt, DOS would simply echo the string `%PATH%`.

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edited by
Trudy Neuhaus

Languages

HOW TO USE TPWIN'S WVSPRINTF FUNCTION

The Turbo Pascal WriteLn procedure lets you print multiple variables of any printable type to the screen with a single statement. It handles all the numeric conversions and formatting for you. Alas, you can't use WriteLn in any but the simplest Turbo Pascal for *Windows* programs. For example, if you want to display mixed character and numeric data in a dialog box, you have to first convert the data into one large null-terminated character string. This could require much use of the Str function (to convert numbers to strings) and the new StrCat function, which concatenates null-terminated strings.

Fortunately, TPWin's WinProcs unit provides access to the wvsprintf function, a *Windows* function found in the USER DLL. Wvsprintf takes a format string and a list of variables and merges them into a formatted text string that has the variables inserted in it. Unfortunately, the manual and on-line help both show the wrong type for the third parameter. From the manual, you'd think that the syntax was

```
wvsprintf(Output, Format, Arglist :
 PChar) : Integer;
```

In fact, the ArgList parameter is not a PChar; rather, it's an untyped pointer that's expected to point to a series of word or LongInt-sized variables.

The Format parameter is a null-terminated string containing text and format control codes, and Output is the buffer that receives the formatted string. The wvsprintf function returns the number of characters in the formatted output if successful, or a number smaller than the length of Format if not.

Also missing from the TPWin documentation is a list of the format control codes used in the Format string. Figure 1 shows the syntax for a format control code. Each begins with a percent sign and ends with a one- or two-letter code. Optional characters specify field width, justification, and other formatting details. The wvsprintf function goes through the Format string from left to right and pulls either a word or a double word (LongInt) from the argument list for each format control code.

> ■ HOW TO USE TPWIN'S WVSPRINTF FUNCTION: Turbo Pascal for *Windows* gives you the wvsprintf function, but doesn't tell you how to use it.

The TPWin program in Figure 2 demonstrates how wvsprintf works. In a program this simple, you actually *could* use WriteLn instead, but wvsprintf still has its virtues. The program starts by defining a data record that holds three words (with a variant that holds a single LongInt). Next, it gains access to an undocumented function of the *Windows* KERNEL DLL with a simple External declaration. When you pass the handle of a DLL to the function GetHeapSpaces, it returns a LongInt containing the number of bytes allocated to that DLL's local heap and the number of bytes *free* in its local heap.

The first line of code after the Label BEGIN loads the LongInt field of the data record with the heap space information from the GDI DLL (note that the function GetModuleHandle is defined in the WinProcs unit). Next it calculates what percent of the heap space is free and stores that information in the data record's Pct field. The call to wvsprintf uses the data record as its ArgList parameter. Each of the %u control codes in the format string is replaced by one word from the record. Since the % sign normally indicates a format control, you have to use a pair of them (%%) to insert an actual percent sign. After this call, the DatStr parameter contains the formatted string, and the next

TURBO PASCAL FOR WINDOWS FORMAT CONTROL CODES

Format control syntax: % [-] [#] [0] [*xxx*] *z*

Code		Action	
%	(Required)	Begins a format specifier	
-	(Optional)	Left-justify the output (the default is right)	
#	(Optional)	Print hex numbers with the 0x prefix	
0	(Optional)	Pad with 0s (the default is a space)	
xxx	(Optional)	Field width (the default is all characters in the field)	
z	(Required)	Type of string—one of the following:	
		s	String—a PChar
		c	Character
		d or i	Integer
		ld or li	LongInt
		u	Unsigned (word)
		lu	Unsigned LongInt
		x	Hexadecimal word
		X	Hexadecimal word, uppercase
		lx	Hexadecimal LongInt
		lX	Hexadecimal LongInt, uppercase

Figure 1: These format control codes are not included in the TPWin documentation.

Computers, FCC Class A, Class B, and You — or When is it better to get a B than an A?

You need to know the difference between computers that meet the FCC class B radio frequency emissions standards and those that meet only the Class A standards.

Computers emit radio signals in their operation. Because these signals may cause interference to radio and television reception, the marketing and the use of computers is regulated by the Federal Communications Commission. Under federal rules, computer users are responsible for remedying interference, including interference in neighboring homes.

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Buyers seeking computers for use in homes (including offices at home) should shop for computers and peripherals which have been Class B certified. These devices carry a label with an FCC ID number. Both new and used Class A verified devices may be sold only for use in commercial and industrial locations. Signals from computers are more likely to be masked by electrical noise from other equipment in such an environment. These areas are also likely to have fewer radios and TVs. Accordingly, equipment marketed only for use in these locations may meet the less rigorous Class A standard. Class B certified equipment may be marketed for use in residences as well as commercial and industrial locations.

As you shop for a computer for use in your home, look for the FCC classification in the specifications or ask your vendor to recommend only machines that have been certified to the Class B limits. TV viewers and radio listeners in your home and in neighboring homes will be glad you did.

Languages

WVSP.PAS COMPLETE LISTING

```
PROGRAM WVsp;
USES WinCRT, Strings, WinProcs;

VAR
  Data : Record
    CASE Boolean OF
      TRUE  : (L : LongInt);
      FALSE : (Free, Avail, Pct : Word);
  END;
  DatStr : ARRAY[0..255] OF Char;
CONST
  PC : PChar = 'Turbo Pascal';

  {Undocumented Kernel function #138}
  FUNCTION GetHeapSpaces(hModule : Word) : LongInt; FAR;
  External 'KERNEL' Index 138;

BEGIN
  Data.L := GetHeapSpaces(GetModuleHandle('GDI'));
  Data.Pct := (LongInt(Data.Free) * 100) DIV Data.Avail;
  wvsprintf(DatStr,'GDI has %u heap bytes free out of '+
                   '%u - %u%% free.', Data);
  WriteLn(DatStr);
  Data.L := GetHeapSpaces(GetModuleHandle('USER'));
  Data.Pct := (LongInt(Data.Free) * 100) DIV Data.Avail;
  wvsprintf(DatStr,'USER has %Xh heap bytes free out of '+
                   '%Xh - %u%% free.', Data);
  WriteLn(DatStr);
  wvsprintf(DatStr,'Again, that''s %u%%', Data.Pct);
  WriteLn(DatStr);
  WriteLn;
  wvsprintf(DatStr,'The PChar, padded to 20 chars with '+
                   'zeroes, is "%020s"', PC);
  WriteLn(DatStr);
  wvsprintf(DatStr,'Its address, treated as a hex '+
                   'LongInt, is %08lx', PC);
  WriteLN(DatStr);
  wvsprintf(DatStr,'The offset is %04X and the segment '+
                   'is %04X',PC);
  WriteLn(DatStr);
END.
```

Figure 2: WVSP.PAS demonstrates various uses of the *Windows* function wvsprintf.

line writes it to the screen.

The program repeats this process for the USER DLL, except that this time it displays the total bytes and free bytes of heap as hexadecimal numbers. The *smaller* of the two percentages displayed is the number *Windows* lists as "Free System Resources" when you click on the Program Manager's Help menu item and select About. Try it! Run the program, then immediately bring up the Program Manager's Help About box.

It's possible to "jump" into the data stream at any point; however, the arguments in the list must be in the same *order* as the corresponding format controls. The next two lines format just the Pct field of the data record. It's also possible to view the same data in different ways by using different format controls. The remaining three calls to wvsprintf format the PChar variable PC as a text string, as a hex LongInt, and as two hex words.

Do try out wvsprintf in a simple program, like the example here. The alternative is to build your formatted string one piece at a time, using Str to convert numbers to strings and StrCat to "glue" the pieces together. The first wvsprintf line in the sample program would require three calls to Str and five to StrCat; all are replaced by a single call to wvsprintf.
—*Neil J. Rubenking*

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by
Jeff Prosise

Tutor

MAKING FILES FIT

Is there any way to copy a file larger than 360K to a 360K disk so it can be transported to the hard disk of another PC?

Gilbert Sunshine
Jersey City, New Jersey

There sure is. If you don't mind the file being split up among several 360K disks, you can use DOS's BACKUP command. For example, if the file is stored in the \DOC directory of drive C:, is named BUDGET.DOC, and you're using drive A: to do the copying, then type

```
BACKUP C:\DOC\BUDGET.DOC A:
```

BACKUP copies the file to drive A:, prompting you to insert more disks. You can reassemble the file in the \DOC directory of the destination PC by placing the first of the disks (be sure to number them in the order they were inserted for BACKUP) in drive A: and typing

```
RESTORE A: C:\DOC\BUDGET.DOC
```

If the destination PC doesn't contain a \DOC directory, RESTORE will create one for you so that it can restore the file to the same directory it came from. RESTORE will prompt you to reinsert the disks in the same order they were inserted for the BACKUP command. One possible glitch you should be aware of is that if the PC you're transporting the disk to runs a different version of DOS than the PC the file came from, RESTORE may not work. One way to ensure that it will is to restore the file on a PC running DOS 5.0. The DOS 5.0 RESTORE command was updated to work with files created with all previous versions of BACKUP.

Another way to go about it is to use Bob Flanders and Michael Holmes' SLICE utility published in *PC Magazine*'s May 16, 1989, Utilities column. SLICE will slice a large file into blocks that can fit on any size disk and will copy the blocks to as many as 99 floppies. When it does, it also creates a utility called SPLICE on the first floppy that reassembles the file at the destination.

- MAKING FILES FIT: How you can fit files larger than 360K on low-density floppy disks.
- USING UPPER MEMORY: How to put the memory addresses between 640K and 1MB to use.
- TURN NUMLOCK OFF AT BOOT-UP: Two ways to turn NumLock off from your AUTOEXEC.BAT file.

If it's important to keep it to just one floppy disk, you'll need a file compression utility such as PKZIP from PKWARE of Glendale, Wisconsin. PKZIP is a shareware program that uses a variety of data compression techniques to compress files—sometimes to 20 percent or less of their original size. A companion program, PKUNZIP, restores a compressed file to its original form. PKZIP also does other things, including allowing you to roll several files into a single compressed file and, if you wish, password-encrypt them. You can obtain PKZIP by contacting PKWARE, 7545 N. Port Washington Rd., Glendale, WI 53217, or by downloading it from the ASP Utils library (LIB14) of PC MagNet.

USING UPPER MEMORY

Is there any way to use the region of memory between 640K and 1MB on a 386 PC without using a 386 memory manager? Can I utilize this address space by using an expanded memory board?

C. Alan Price
Houston, Texas

The expanse of memory from 640K to 1MB, termed the *upper memory area* (UMA), is normally reserved for hardware use. For example, the video buffer (the region of memory where the data that determines what is displayed on the screen is stored) is located there. So is the ROM BIOS, and so are the ROMs used by other adapters in your system such as video adapters and hard disk controllers. Expanded memory boards usually locate their page frames there (the area of memory that EMS pages are mapped into), so expanded memory does, in a sense, allow you to make use of the UMA, if only indirectly. Normally, regions of the UMA that are not populated by adapter ROM or other upper memory entities are dead space that can't be used for anything. There's no RAM there, so DOS can't use it. It's simply empty address space, and it's of no practical use until it's filled.

Enter the 386 memory manager. One role that the 386 memory manager plays is that of a UMB (upper memory block) provider. UMBs are pockets of usable RAM created in unused areas of upper memory. A 386 memory manager converts empty address spaces into usable RAM by *backfilling* them with memory from above the 1MB mark. Backfilling is accomplished by switching the PC to protected mode, in which the memory manager can access up to 4 gigabytes of RAM, and running DOS in a Virtual-86 mode session that, to application programs, appears no different from the real mode that DOS programs normally run in. The advantage to running in Virtual-86 mode is that memory addresses below 1MB can be transparently mapped to addresses above 1MB, using a feature of the 386 called *paging* (for a fuller discussion of paging and how it is used to create UMBs, refer to the January 16, 1990, Tutor column).

Say, for example, that the 386 memory manager determines that the region of memory from segment C000h to CFFFh

is currently unused. It sets up the 386 page tables so that any memory access directed to a location in that region is rerouted to an address in extended memory. Then it treats the region from C000h to CFFFh as normal RAM and allows DOS to do likewise. When a program reads or writes a byte of memory in this region, the 386 actually reads or writes the location in extended memory that corresponds to the memory address. The application program is none the wiser, thinking that it accessed data stored between 640K and 1MB. The primary use for UMBs is to store TSRs and device drivers, where they won't take away memory from application programs running in the lower 640K.

386 memory managers do other things, too. In addition to setting up UMBs, they typically put on the cloak of an expanded memory manager (EMM) and provide expanded memory to programs that use it. Just as they do when they substitute extended memory for upper memory, they store data written to expanded memory in extended memory. In effect, they convert extended memory to expanded memory, allowing users whose systems are equipped only with extended memory to adapt the makeup of their PCs to suit the type of application program being run.

Do you have to have a 386 memory manager to put upper memory to work? In general, yes. But you can buy a 386 memory manager for a fraction of the cost of an expanded memory board. Two of the more popular memory managers are *386MAX* from Qualitas and *QEMM-386* from Quarterdeck Office Systems, both of which we've mentioned in this column many times in the past.

The big news, however, is that when you upgrade to DOS 5.0, you get a 386 memory manager for free. It's called EMM386.EXE, and it does much of what *386MAX* and *QEMM-386* do (although *386MAX* and *QEMM-386* will do some things EMM386.EXE won't, such as swapping fast 32-bit RAM for slow 8-bit ROM). With EMM386.EXE installed, you can use DOS 5.0's LOADHIGH and DEVICEHIGH commands to load TSRs and device drivers into upper memory, as described in the September 24, 1991, Tutor column.

Soon we'll see application programs that can also use upper memory to relieve RAM cram in the lower 640K. Veteran DOS users will agree that such relief won't come a moment too soon.

TURN NUMLOCK OFF AT BOOT-UP

I use an IBM Model 50Z that boots up with NumLock on. I'd like to find a way to turn it off from my AUTOEXEC.BAT file. Can you suggest a means for doing so?

Charles J. Hervey
Norwalk, Connecticut

That's an easy one. If you have access to PC MagNet, you can download a copy of TOGGLE.COM, which was published in the May 31, 1988, Utilities column. TOGGLE allows you to toggle NumLock, CapsLock, and ScrollLock on or off from the command line or inside a batch file. To turn NumLock off, all you have to do is add the command

```
TOGGLE -N
```

to your AUTOEXEC.BAT file.

As an alternative, you can create a short utility to toggle NumLock on or off with the DEBUG script in Figure 1. When executed inside DEBUG, this series of instructions creates NUMLOCK.COM. With NUMLOCK.COM in hand, typing

```
NUMLOCK +
```

turns NumLock on, while the command

```
NUMLOCK -
```

turns NumLock off. It works by setting or clearing bit 5 of the byte at 0040:0017, which, among other things, controls the current settings of CapsLock, NumLock, and ScrollLock. If bit 5 is 1, then NumLock is enabled; if it's 0, then NumLock is disabled. You can enable and disable CapsLock and ScrollLock by manipulating bits 6 and 4, respectively. The other bits in this byte indicate whether the Alt, Ctrl, and Shift keys are currently depressed (for example, if the Left Shift key is held down, bit 2 is set to 1) and whether insert mode is enabled or disabled. The keyboard BIOS treats the Ins key just as it does the three Lock keys, toggling a bit in the BIOS data area each time Ins is pressed. Most programs, however, ignore this bit, opting instead to process presses of the Ins key themselves.

NUMLOCK.SCR

```
A 0100
CLD
MOV  SI,0081
MOV  AX,0040
MOV  ES,AX
LODSB
CMP  AL,20
JZ   0109
CMP  AL,0D
JZ   0127
CMP  AL,2B
JNZ  011D
ES:
OR   BYTE PTR [0017],20
RET
CMP  AL,2D
JNZ  0127
ES:
AND  BYTE PTR [0017],DF
RET

N NUMLOCK.COM
RCX
28
W
Q
```

Figure 1: When executed within DEBUG, this script creates NUMLOCK.COM, a utility that toggles NumLock on and off.

One thing to be aware of when you use either TOGGLE or NUMLOCK is that on most PCs, the keyboard LED that indicates the state of NumLock will toggle, too. That's because the PC BIOS periodically checks the Lock states as recorded in the byte at 0040:0017 and ensures that the indicator light stays in sync. However, some third-party BIOSes don't do this, and therefore permit NumLock and the NumLock indicator light to get out of phase with each other. The problem is compounded if you add a third-party keyboard to your PC that the BIOS wasn't designed to work with. In this case, the BIOS may attempt to toggle the indicator light but fail because the commands it outputs to the keyboard are not what the keyboard expects. Fortunately, this problem will only manifest itself on a small minority of systems.

ASK THE TUTOR

The Tutor solves practical problems and explains techniques for using your hardware and software more productively. Questions about DOS and systems in general are answered here. Write to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload your submission to PC MagNet (see page 10 for instructions). We regret that we can't acknowledge submissions or answer questions individually. ■

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MOTOROLA

CIRCLE 367 ON READER SERVICE CARD

by
Frank J. Derfler, Jr.

Connectivity

LAN MANAGER-VECTRA CONFLICT

We recently tried to install a number of Hewlett-Packard Vectra computers on a network running Microsoft's *LAN Manager* network operating system. During boot-up we consistently received an error message reporting a NETBIND failure. We finally traced the problem to an HP utility called PAM that is installed by each computer's CONFIG.SYS file.

When the *LAN Manager* drivers are loaded, a file called PROTMAN.SYS stores data in the High-DOS address space, but the data isn't protected. NETBIND reads and uses this data when the PC tries to join the network. But when the PAM program installs, it overwrites the data area, leaving nothing for NETBIND to use.

The solution is easy: Just remove the line `SHELL = PAMCODE` from each CONFIG.SYS file and the problem disappears.

John T. Cronin
St. Louis, Missouri

PC MAGAZINE Network managers need to know what every line of every CONFIG.SYS file in every networked PC does. Keeping careful control over CONFIG.SYS files is the best way to exercise strict memory management on networked PCs and to prevent those I/O or memory address conflicts that can be intermittent and frustrating. It also makes it easier to control the infiltration of viruses into the network.

NOT-SO-STANDARD STANDARDS

I work in the PC support group of a major insurance company. My greatest frustration comes from trying to connect modems, plotters, printers, and other devices to PCs through their RS-232 serial ports. It seems that no products or category of products use the same connections. We've developed six different cables that we try for each installation—and despite this we often run into something new. Isn't there a standard?

Mark Whaller
Chicago, Illinois

- LAN MANAGER-VECTRA CONFLICT: Make sure you know what your CONFIG.SYS file is doing.
- NOT-SO-STANDARD STANDARDS: The different ways the RS-232 standard is implemented makes PC support difficult.
- USING LARGE DRIVES UNDER NETWARE: Older versions of *NetWare* can't handle large hard disks.
- USING THE RPRINTER UTILITY: Avoid loading RPRINTER.EXE (and other TSRs) from a login script.

PC MAGAZINE There are standards, including the 1987 version of RS-232D, but products vary in how they implement both the standard and in how they write communications software to use the standard. It's high time that the industry started delivering more devices with self-configuring serial ports. Today, certain types of printer-sharing devices (see "Buffered Printer-Sharing Devices," *PC Magazine*, April 30, 1991) can automatically detect and adapt to differences in wiring, signaling speed, and other parameters, but too many devices don't have such capabilities. Processing power is cheap and the technology for designing self-adaptive RS-232 devices isn't tough, but few manufacturers offer self-adaptive ports.

Anyone in the PC support business should know about the Smart Cable Maker from IQ Technologies. This device interfaces two RS-232 asynchronous devices and provides a graphical display of the proper cable setup. It also functions as a breakout box so you can match things up manually. The Smart Cable Maker carries a retail price of $149.95 and even if you only use it a couple of times, you've probably paid yourself back. IQ Technologies is located in Bothell, Washington. Give them a call at 800-227-2817 to find the nearest dealer.

USING LARGE DRIVES UNDER NETWARE

Since we installed a new 600MB hard disk drive on our network, we've experienced problems running *NetWare*, Version 2.15c. Specifically, some of our files are getting corrupted some of the time. To make matters worse, the problem is intermittent. What's going on?

Sam Fujikawa
Narita, Japan

PC MAGAZINE There is a known problem (corrected in *NetWare* 2.2) with the way older versions of *NetWare* handle drives having more than 1,024 cylinders. I can't be sure that this is the case in your system, but the symptoms are the same. Whenever an un-patched *NetWare*, Version 2.1*x* tries to write to a drive cylinder over 1,024, it subtracts 1,024 from the correct cylinder number and writes to the resulting incorrect cylinder number. There are a few ways to deal with the problem: Your *NetWare* dealer can provide patches to fix your version, you can get the patches from the Novell forum on CompuServe, or you can upgrade to *NetWare* 2.2*x*. And some manufacturers of large hard disk drives can provide an intelligent BIOS on the disk controller that makes the drive's geometry appear like that of a more typically

configured drive.

One thing's for sure: If the 1,024 sector overlap is the problem in your system, you *will* have to deal with it. Eventually the drive will overwrite NET$OS.EXE, and you'll lose your server.

USING THE RPRINTER UTILITY

Mr. Mueller's letter in the May 14, 1991, issue suggests loading RPRINTER (Novell's remote printer-sharing facility) from within a Novell login script. RPRINTER and the PSERVER utility, allow you to share printers that are attached to workstations other than the file server. But this technique takes about 70K more RAM than necessary because it violates an important rule: Never load a TSR from the login script.

Since RPRINTER loads while LOGIN.EXE is still in memory, LOGIN .EXE leaves behind an unusable hole of about 70K in RAM when it exits. Look carefully at any lines in a login script marked for external execution with the # prefix to make sure the program being executed isn't a TSR.

A much better idea is to load RPRINTER from the AUTOEXEC.BAT file of the machine making the printer available for sharing. Here's the AUTOEXEC.BAT I use on my machine:

```
F:
ECHO Preparing shared printer.
 This might take several tries.
:PRINT
RPRINTER PS1 1 -R
RPRINTER PS1 1
IF ERRORLEVEL1 GOTO PRINT
LOGIN
```

The IF ERRORLEVEL1 line in the batch file prevents a problem from occuring: If you reboot the computer using Ctrl-Alt-Del, PSERVER takes a minute or two to release the printer for reassignment. So when AUTOEXEC.BAT tries to load RPRINTER the first time, it's told the printer is already in use. If the batch file just continued, the printer would never be available for sharing. Instead, this loop forces AUTOEXEC to wait until PSERVER releases the printer for assignment.

You don't need to create a dummy user. Just copy RPRINTER.EXE to the \LOGIN directory and flag it as shareable and read-only.

There's one problem with this method: You must customize the AUTOEXEC.BAT file of every PC sharing a printer across the network. There's another approach you can use if you need the same AUTOEXEC in all client PCs. First create a dummy user called PRINTER_CHECK with this login script:

```
SET PSTAT="%P_STATION"
EXIT "FINISH.BAT"
```

Then put the batch file shown in Figure 1 (I called it FINISH.BAT) in the LOGIN subdirectory. Now you can follow Mr. Mueller's sugggestion to complete the AUTOEXEC.BAT file by inserting the following lines:

```
F:
LOGIN PRINTER_CHECK
LOGIN
```

This technique avoids loading a TSR from within a login script because the EXIT comment allows LOGIN.EXE to unload before FINISH.BAT starts.

Eric Hart
Ithaca, New York

FINISH.BAT — COMPLETE LISTING

```
IF "%PSTAT%"=="0123456789ABCDEF" THEN GOTO PR1
IF "%PSTAT%"=="ABCDEF0123456789" THEN GOTO PR2
GOTO EXIT
:PR1
RPRINTER PS1 1 -R
RPRINTER PS1 1
IF ERRORLEVEL 1 GOTO PR1
GOTO EXIT
:PR2
RPRINTER PS1 2 -R
RPRINTER PS1 2
IF ERRORLEVEL 1 GOTO PR2
:EXIT
```

Figure 1: This batch file lets you use Novell's remote printer-sharing facility without loading it from a login script.

Mr. Hart's FINISH.BAT is a good example of how to use the short form of the IF P_STATION command. Of course, the 16-digit alphanumeric sequence after IF "%PSTAT%" would contain the unique address of the Ethernet or Token-Ring adapter in each PC acting as a print server. The THEN GOTO statement can point to the appropriate set of RPRINTER commands for each PC making a printer available to the network.

> One important rule for anyone who creates login scripts on a *NetWare* LAN is: Never load a TSR from the login script.

Mr. Hart's warning about running TSRs from a login script is right on the money. Les Freed, coauthor of *The PC Magazine Guide to Using NetWare*, lays down four important rules concerning login files:

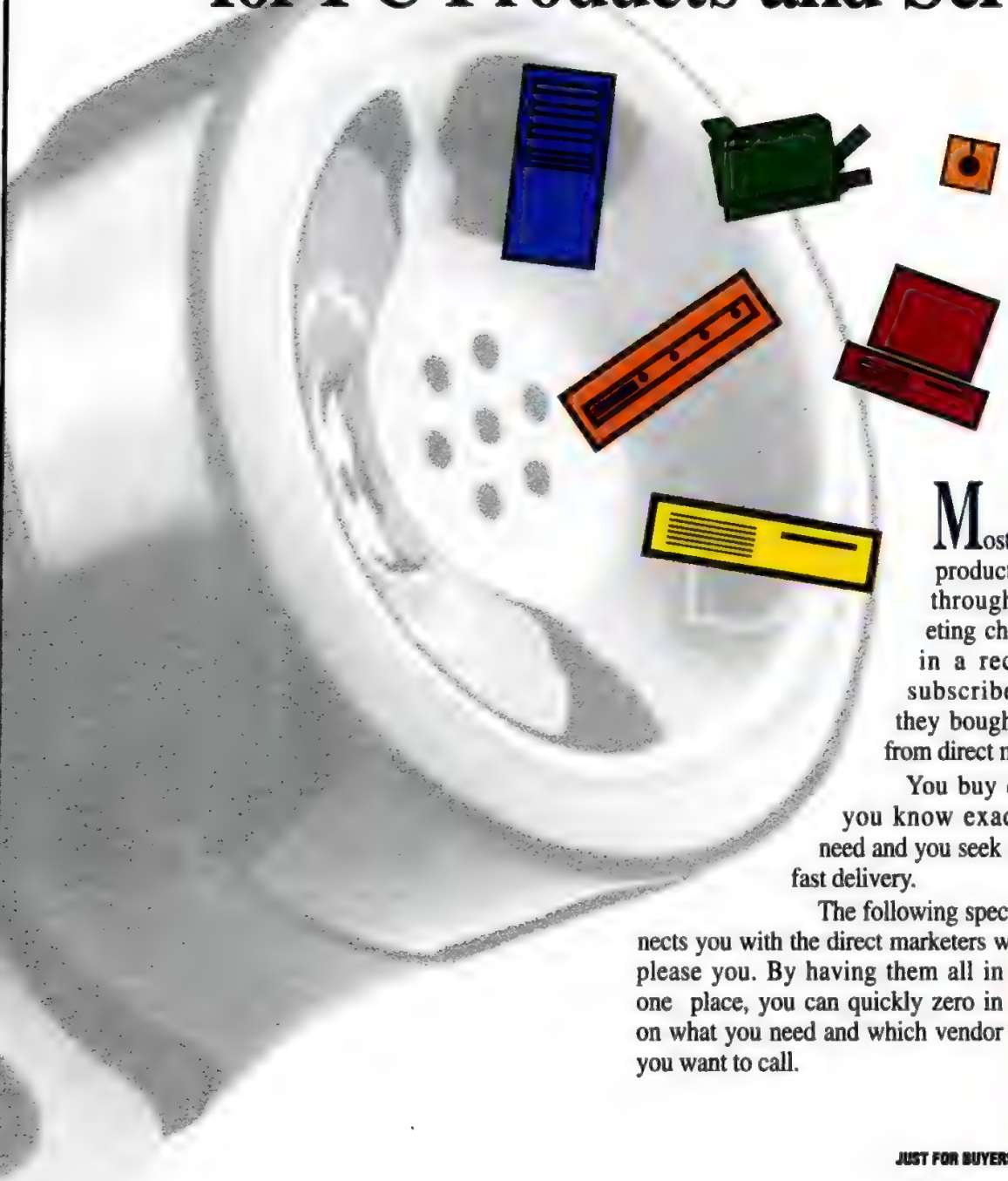
- Never run a TSR from a login script file.
- Don't use the DOS PATH command from a login script file.
- Use COMSPEC carefully to avoid DOS compatibility problems.
- Use EXIT, not EXEC to launch a DOS program.

These are all good rules for anyone who manages or creates login scripts on a *NetWare* LAN.

NETWORK YOUR QUESTIONS

Connectivity gives you practical solutions to networking problems of all types. We'll pay $50 for any tips we print. Please submit your letter on-disk along with a printout. Then mail your contributions to Connectivity, *PC Magazine*, One Park Avenue, New York, NY 10016. You may also contact Frank J. Derfler, Jr. via MCI Mail (MCI ID: 240-7931) or via the LAN Labs fax machine (904-837-0737). We regret that we're unable to acknowledge submissions or answer letters individually. ■

PC Magazine's Direct Marketing Connection for PC Products and Services



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PC MAGAZINE

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- ✓ 200 watt power supply
- ✓ 14" Super VGA color monitor with 16 bit VGA card with 512K.
- ✓ Clock calendar, parallel port, two serial ports, and game port.
- ✓ Key Tronic 101 key keyboard.
- ✓ 8 expansion slots, 5 drive bays.
- ✓ 80387-SX coprocessor socket.
- ✓ Full Shadow RAM and LIM 4.0 EMS support.
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- ✓ FCC Class B approved.

386/SX20	40mb	80mb	100mb	200mb
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- ✓ 200 watt power supply
- ✓ 14" Super VGA color monitor with 16 bit VGA card with 512K.
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- ✓ Key Tronic 101 key keyboard.
- ✓ 8 expansion slots, 5 drive bays.
- ✓ 80387-SX coprocessor socket.
- ✓ Full Shadow RAM and LIM 4.0 EMS support.
- ✓ Windows & Mouse add $69.
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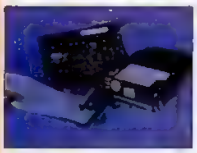

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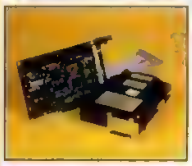

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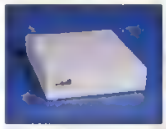

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Mono VGA	$799	$929	$999	$1 249
VGA Color	$949	$1,079	$1,149	$1 399
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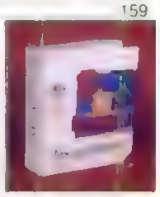

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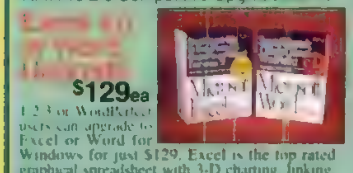

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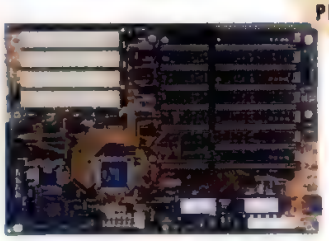

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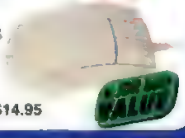

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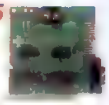

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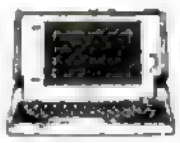

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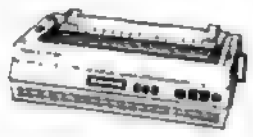

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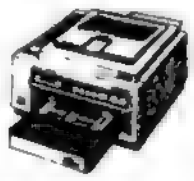

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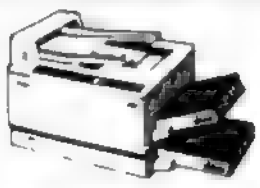

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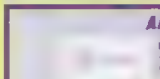

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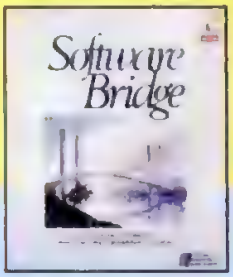

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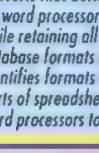

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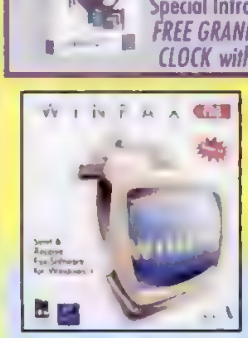

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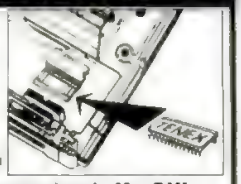

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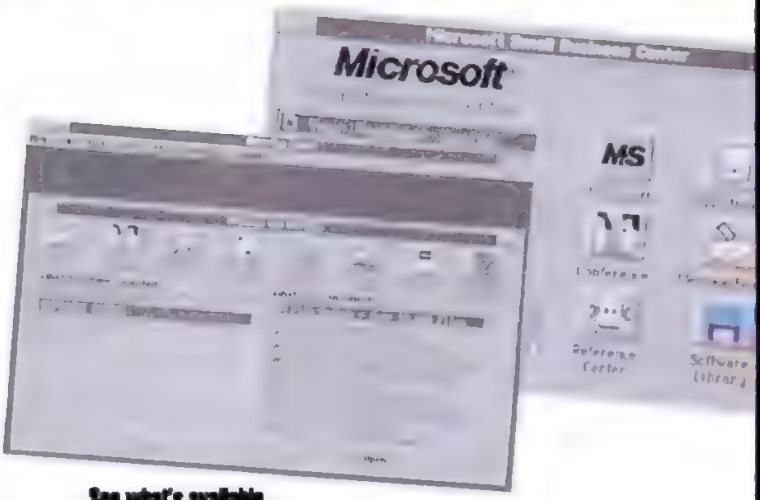

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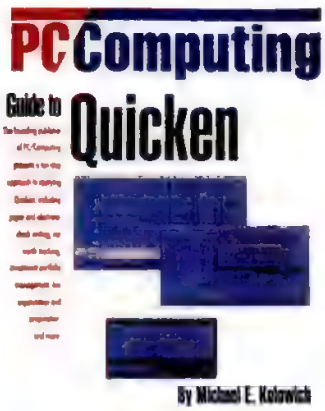

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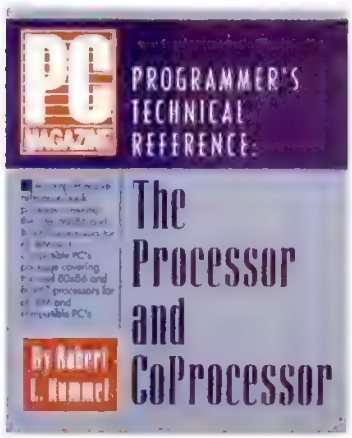

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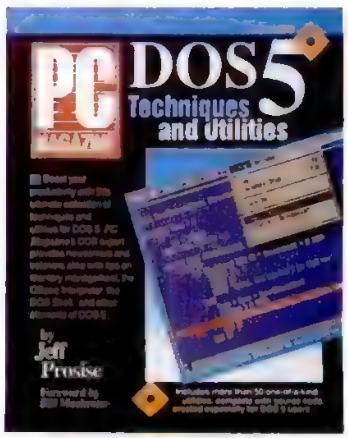

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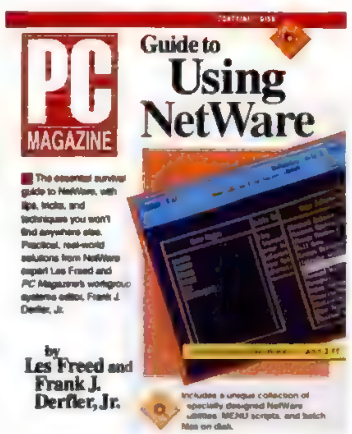

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DOS 5.0 AND FASTBACK

I recently bought DOS 5.0 and I guess I like it, although I have yet to see any speed increase. But there's an incompatibility I've noticed that I wanted to advise you about. If you put EMM386.EXE in your CONFIG.SYS file, *Fastback* won't run; in fact, it won't do the DMA test, but will freeze with the floppy light on. Any advice?

Joel D. Hencken
Watertown, Massachusetts

The problem lies not with DOS 5.0, but with assumptions made by some language compilers about the amount of memory available in the system.

Because DOS 5.0 has the ability to load most of itself into the HMA (high memory area), the first 64K of conventional memory is freed up, causing problems with programs that don't expect to be loaded there. Symptoms of this are when you get a "Packed File Corrupt" message when trying to load a program, or the system locks up completely, or an application that ran fine under an older version of DOS stops working properly under 5.0.

Microsoft included a program called LOADFIX in DOS 5.0, which loads the application above the first 64K block, solving most of these problems. LOADFIX is documented in chapter 4 of the *MS-DOS Getting Started* manual that comes with the DOS 5.0 package. The syntax is simple; just run

```
LOADFIX filename
  [Parameters]
```

where *filename* is the name of the application's executable file.

Another fix for older applications that DOS 5.0 provides is SETVER. This program changes the DOS version number reported to applications listed in its internal table, and is initially loaded in CONFIG.SYS. A number of applications are predefined, and adding more is easy; for example, to add FOO.EXE to the table, and identify it as a DOS 3.30 program, just run "SETVER FOO .EXE 3.30" at the command prompt. SETVER is documented in chapter 14 of the *MS-DOS User's Guide and Reference*.

The installation program copies two text files to your DOS directory that provide information on running certain applications and devices under DOS 5.0. APPNOTES.TXT tells users what's needed to run a number of programs under 5.0, including *Fastback*, *Lotus 1-2-3* 3.0 or later, *Paintbrush* 2.0, and *GeoWorks Ensemble*. README.TXT gives advice on installing various hardware devices, memory management, *Microsoft Windows*, and networks. It also includes documentation corrections and additions. DOS 5.0 users should read both files for help with problems and for making effective use of DOS 5.0 on their system.

GW-BASIC AND QuickBASIC

I have read that the new DOS 5.0 program replaced GW-BASIC with QuickBASIC. I am concerned, because I write all my programs in GW-BASIC: I think it is one of the easiest programs to learn and use, and I disagree that GW-BASIC is a hoary program. But if QuickBASIC is an edited remake of another program, can it be that good?

Keith Mifflin
Cottage Hills, Illinois

What do you do to obtain recent versions of products like Microsoft GW-BASIC? And what will happen to GW-BASIC now? Since it wasn't included or updated with MS-DOS 5.0, will Microsoft discontinue it?

Nicholas Rosasco
Arnold, Maryland

GW-BASIC has been discontinued by Microsoft and replaced with a version of QuickBASIC that is included with DOS 5.0. As it was never released or sold as a separate product, the only way to get the absolute latest version of GW-BASIC is to purchase a copy of DOS 4.01.

All is not lost, though: The QuickBASIC in DOS 5.0 is backward-compatible with GW-BASIC, and a program called REMLINE.BAS is included to convert GW-BASIC programs to QuickBASIC format by removing the line numbers from the source code, as they are no longer used (except for labels and GOTOs). You might also find QuickBASIC even easier to program in; it includes a full-screen program editor; it also provides documentation for all the BASIC functions and commands in the on-line help facility.

The biggest difference between the commercial version of QuickBASIC (Microsoft Corp., Redmond, WA 98052; 800-426-9400, 206-882-8080; $99) and the one in DOS 5.0 is that the latter is only an interpreter (like GW-BASIC); the ability to compile executable programs from your BASIC source code was removed.

3.5-INCH TAPE DRIVES

My 386 is housed in a mini-tower case. Like most typical mini-towers, it has two openings for 5.25-inch drives and two openings for 3.5-inch drives. I have one 1.2MB 5.25-inch drive and one 1.44MB 3.5-inch drive, leaving free one opening of each type.

I was planning to leave the 5.25-inch opening available for an internal CD-ROM drive. The 3.5-inch opening seems sort of useless, since I don't plan on getting another 3.5-inch floppy drive. It seems as though the only other peripheral that could fit into a 3.5-inch opening would be an internal tape drive. Are there any manufacturers who make this kind of device?

Bobby F. Kuo
Somerville, Massachusetts

Advisor

A number of manufacturers make 3.5-inch internal tape drives; to list all of them would probably take up this whole column. The biggest differences between the various makes and models are the capacity of the drive (how much data it can back up), the type and size of the tape cartridges, and whether it requires its own adapter card, or if it can work off the floppy/hard disk controller already present in the PC (usually through a special adapter cable that replaces the existing floppy disk drive cable, at an extra cost).

Here's just a sampling of the different internal drives available: the FileSafe 4000 (Mountain Network Systems, Campbell, CA 95008; 800-458-0300, 408-379-4300; $389 for the internal model) provides either 40MB or 60MB storage, depending on the tapes used. Irwin Magnetic Systems Inc. (Ann Arbor, MI 48105; 800-421-1879, 313-930-9000) has a wide range of internal tape drives, including the 40MB SX ($419) and the 80MB 80SX ($799).

The Jumbo Tape Backup System (Colorado Memory Systems Inc., Loveland, CO 80537; 800-346-9881, 303-669-8000) comes in a number of different capacities, including 120MB ($399) and 250MB ($499).

Other internal tape drive vendors include Maynard Electronics (Lake Mary, FL 32746; 800-821-8782, 407-263-3500), Emerald Systems Corp. (San Diego, CA 92128; 619-673-2161), Tallgrass Technologies Corp. (Lenexa, KS 66214; 800-825-4727, 913-492-6002), and Techmar (Solon, OH 44139; 800-624-8560, 216-349-0600).

Your best bet is to decide what capacity you need, and then contact the vendors to find out which of their drives supports your particular system. Installing an internal tape drive can be tricky, so be sure that you buy from a dealer or vendor who is willing to provide technical support.

BAD CRCs

For four years I have been using a Tandy 1000TX with a hard disk drive and a Tandy 1,200-bit-per-second modem. When downloading text or ASCII files, I have no problems, but if I try to download a binary file, I have problems 99 percent of the time. When using *ProComm* I get a bad cyclic redundancy check (CRC). I have also had the same problems using *Eight-In-One* and *WordStar* to download. When we had a local bulletin board I didn't have any trouble.

A second problem I have is when using *Windows* or *Micrografx Draw Plus*, the mouse doesn't always work unless I put the computer in slow mode. I don't know if the two problems are related. Any help?

Alfred Saunders
New Braunfels, Texas

The two problems might be related, but you don't specify if your mouse is a bus or serial type, so I can't say for sure. Slowing down the computer before downloading a file may solve the problem, but at 1,200 bps, the speed of the download shouldn't be a factor.

Getting a bad CRC occasionally during a download isn't really a problem, unless you're getting so many that the download aborts.

The reason you see only bad CRCs when doing a binary download is that the transfer protocol you're using (Xmodem or Ymodem) is doing its job, making sure that the data you receive is correct. During an ASCII or text transfer, your communications program files the data away "as is," and doesn't do any checking to see if the text you receive is the same as the text sent by the host. Generally, this isn't a problem, as the worst that can happen is that some of the text gets garbled during the transmission.

However, binary data is more sensitive to errors; one bad byte can make the data or program worthless, and cause all kinds of problems when you attempt to run the program, or extract the compressed files from the downloaded archive.

The most common cause of errors during transmission is line noise on the phone lines. The chance of noise occurring increases with the distance of the call, as it is going through more switching stations, relays, and even satellite links. This has always been a problem with data transfers over standard phone voice lines (though the situation has been getting better as more and more phone companies switch to digital links), and was the primary reason for the development of the error-checking and correcting transfer protocols such as Xmodem, Ymodem, and Zmodem.

Using Xmodem as an example, here is what happens during the file transfer: The sending computer breaks the data down into 128-byte blocks, and then calculates the total of all the bytes in that block. This total becomes the CRC number, and is tagged onto the end of the block to be transmitted.

The receiving system does the same calculation, and compares the total it gets with the total the sending system sent it; if they don't match, it reports a "bad CRC" and asks the host to retransmit the bad block. The number of times this can happen before the transfer is aborted varies with the different protocols used. For more details on the different transfer protocols, check the introduction to the article "Asynchronous Communications Software: Improving Information Access" in the April 30, 1991, issue.

ARTS & LETTERS UPDATE

I have a 386 with an 80MB hard disk, 4MB of RAM, and a VGA adapter. I tried to run Computer Support Corp.'s *Arts & Letters Editor*, Version 1.04, in *Windows'* Real mode and obtained this error message: "Drawing Task for Arts & Letters. . .cannot be executed."

Is there any way I can run this version in *Windows'* Real mode without upgrading?

Jake Kohne
(no address given)

Sorry to be the bearer of bad news, but the answer is no: The version of *Arts & Letters* that you have is over two years old, and isn't supported under *Windows* 3.0. The changes from *Windows* 2.x to 3.0 were significant enough to require that most programs be updated to work properly in the new environment.

The current version of *Arts & Letters Editor* is 3.1; it is available from Computer Support Corp. (Dallas, TX 75244; 214-661-8960) for an upgrade fee of $249 (the retail price is $695). You may find it worthwhile to upgrade, as the latest version comes with over 5,000 clip-art samples, and supports the latest *Windows* enhancements, including *Adobe Type Manager*.

FINDING SPEEDSTOR

On *PC Magazine*'s recommendation, in early 1988 I purchased *SpeedStor* from Storage Dimensions in Los Gatos, California. Recently I attempted to contact the company to get an upgrade and found that the number had been disconnected.

C.E. Courtright
Antiguo Cuscatlan,
El Salvador

Storage Dimensions is alive and well, and can be reached at 408-879-0300 in San Jose, California. The current version of *SpeedStor* retails for $99, and supports DOS 2.0 through 5.0.

Information on the current location of a computer vendor can be easily researched through the *Computer Directory*, which is a part of ZiffNet, Ziff-Davis' online service that includes PC MagNet. The *Computer Directory* is a searchable database of just about all the hardware and software products and vendors currently on the market. It is an extra-cost service, but searches are very fast, and in most cases cost only $2 to $3.

Information on joining PC MagNet can be found on page 10 of this issue; once you've joined, type GO ZNT:COMPDIR to reach the *Computer Directory*. The menu has various options that explain the costs for searches and the methods you should use to make the search as efficient as possible.

ASK THE ADVISOR

Send your question to PC Advisor, One Park Avenue, New York, NY 10016, MCI mailbox PC MAGAZINE, or upload it to PC MagNet (see the instructions for joining on page 10 of this issue). Sorry, but we cannot send personal replies. ■

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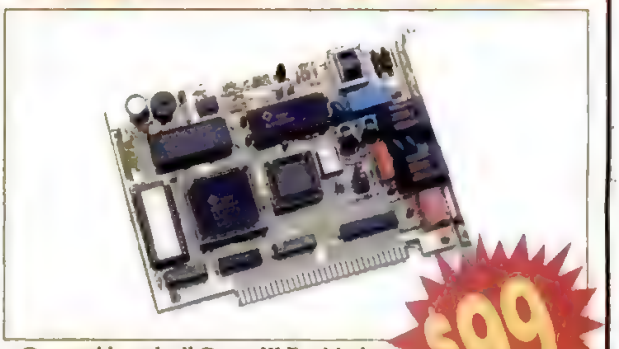

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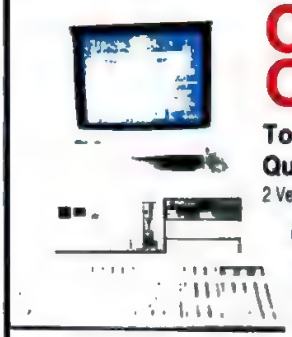

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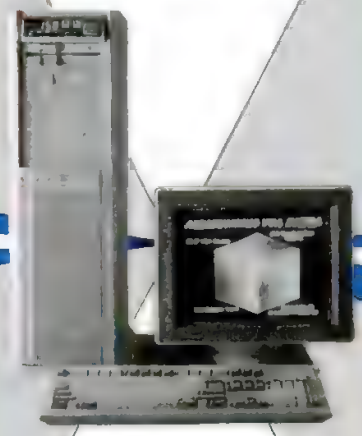

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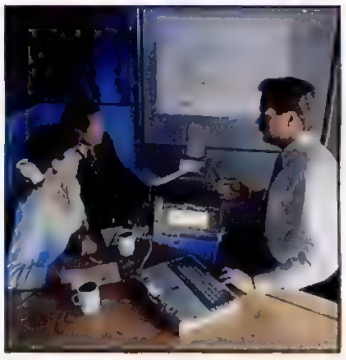

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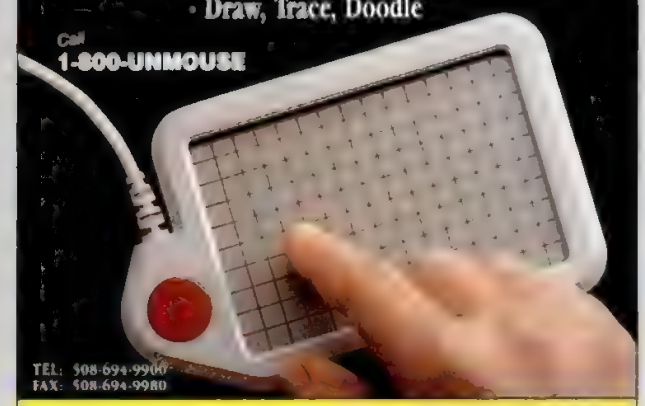

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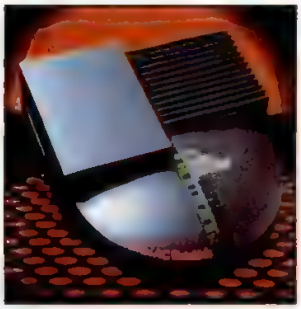

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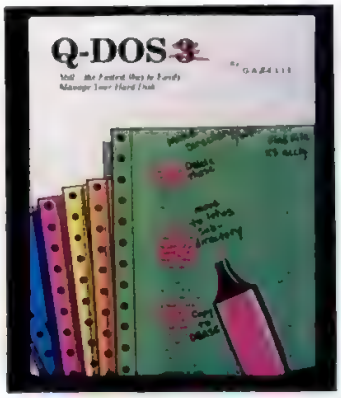

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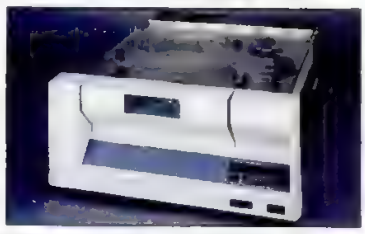

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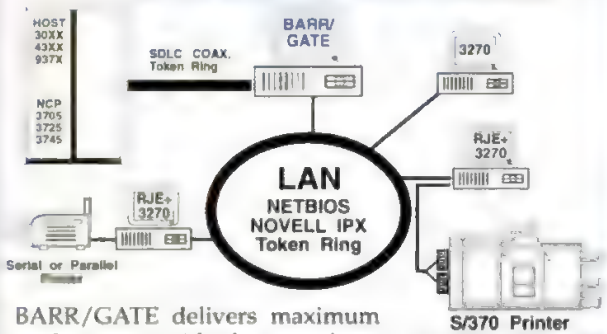

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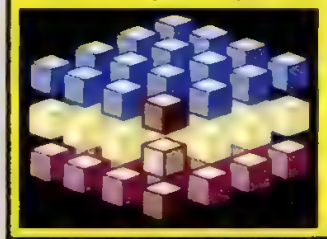

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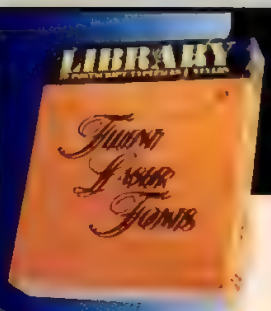

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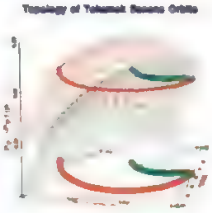

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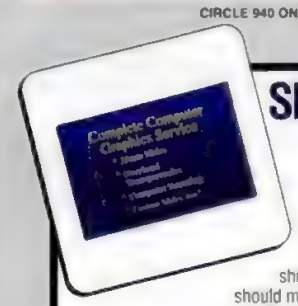

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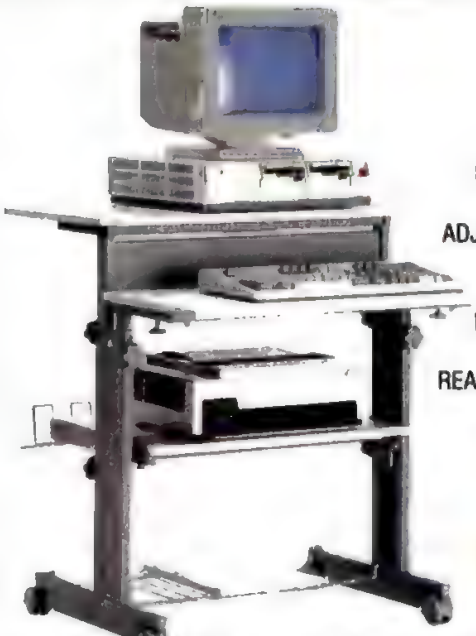

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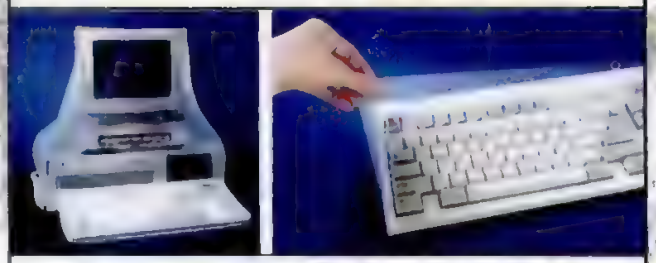

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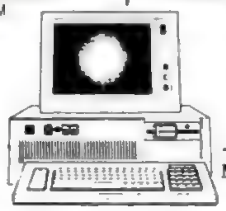

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- 5.25" Disk
- 3.5" Disk
- 40 MB Hard drive
- 256K Super VGA Card
- 2Serial ports
- One parallel port
- Game port
- 101 Keyboard
- 14"VGA Color Monitor
- MS DOS 4.01

$1,069

80386-25MHZ
K2530 212X

- Desktop case
- 2MB xpndble to 8MB
- 5 25" Disk
- 3.5" Disk
- 124 MB Hard drive
- 256K Super VGA Card
- 2Serial ports
- One parallel port
- Game port
- 101 Keyboard
- 14"VGA Color Monitor
- MS DOS 5.0

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80386SX-16MHZ
P1660 240X

- Slimline case
- 2MB xpndble to 5MB
- 5 25" Disk
- 3.5" Disk
- 40 MB Hard drive
- 256K Super VGA Card
- 2Serial ports
- One parallel port
- Mouse port
- 101 Keyboard
- 14"VGA Color Monitor
- MS DOS 4 01

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80386-33MHZ
K3304 421x

- Tower case
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- 1MB Super VGA Card
- 2Serial ports
- One parallel port
- Game port
- 101 Keyboard
- 14"VGA Color Monitor NI
- MS DOS 5.0

2,561

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P2030 289X

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- 4MB xpndble to 5MB
- 5.25" Disk
- 3.5" Disk
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- 2Serial ports
- One parallel port
- Game port
- 101 Keyboard
- 14"VGA Color Monitor
- MS DOS 4.01

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80486-33MHZ
F3302 821x

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- 3.5" Disk
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- 2Serial ports
- One parallel port
- Game port
- 101 Keyboard
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- MS DOS 5.0

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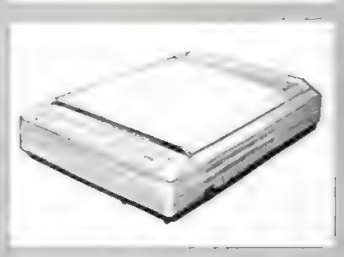

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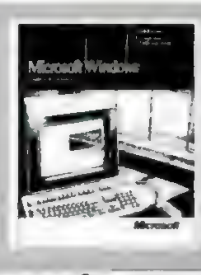

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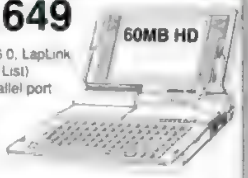

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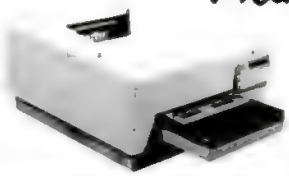

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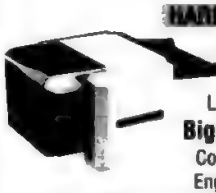

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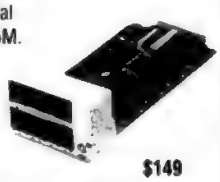

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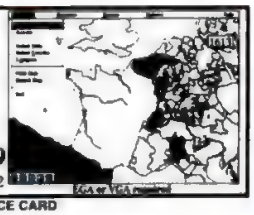

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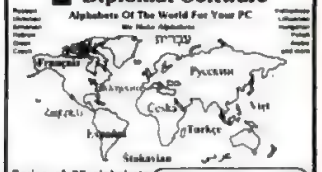

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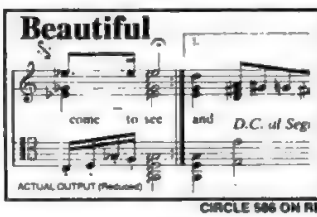

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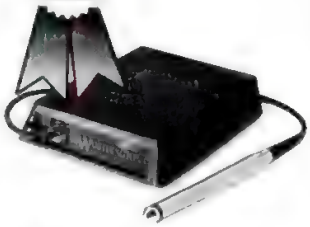

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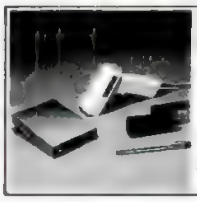

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6. Are there any PCs in your office? (Check all that apply.)
01. ☐ Linked to mainframe
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03. ☐ Networked together

7. Please check the equipment currently installed at your location: (Check all that apply.)
01. ☐ IBM or Compatible PCs
02. ☐ IBM or Compatible Mainframes
03. ☐ IBM or Compatible Minis
04. ☐ Macintosh

8. Do you plan to buy any PC Products?
01. ☐ Now
02. ☐ In 4 to 6 months
03. ☐ In 7 to 12 months
04. ☐ No definite plans

9. Number of Employees in your entire company:
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PC MAGAZINE Coming Up

■ DRIVE ARRAYS

A hard disk failure costs you time and money. Drive arrays are designed to make backup automatic and repairs a snap. *PC Magazine*'s first feature on drive arrays will define the technology (known as RAID—Redundant Arrays of Inexpensive Drives) and help you decide whether you need the fault tolerance and data backup these devices claim to provide. We examine internal and external arrays from ALR, Ciprico, Compaq, CORE International, Dell, Northgate, and Tangent.

■ NONPROGRAMMABLE DATABASES

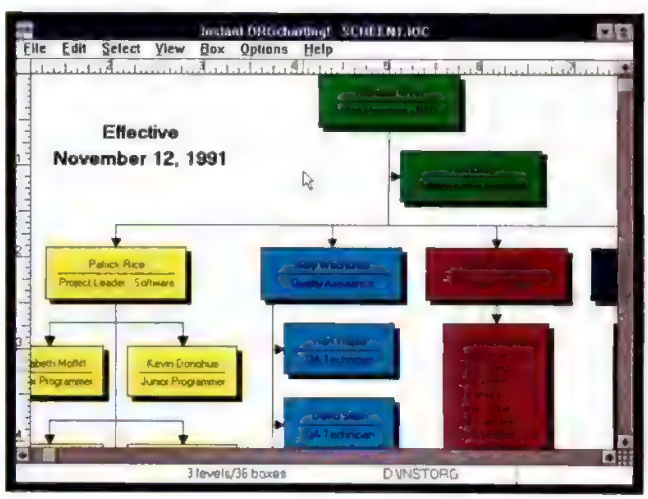
Are you still using your spreadsheet as a database? Most PC users need to do database work, but not everyone needs the relational power of a *Paradox* or *dBASE IV*. PC Magazine Labs examines the features of ten low-cost nonprogrammable databases, including the latest versions of *Q&A* and *PC-File*.

■ LOW-COST CAD

Many designers and engineers need more precision drawing tools than they can find in an illustration package, but they don't want to spend a fortune. If you have many engineers, you may need an inexpensive way of supporting your pricey *AutoCAD* workstation. Powerful yet low-cost 2-D CAD software is the perfect alternative. PC Labs puts 11 2-D CAD packages through their paces, including *DesignCAD 2D* and *FastCAD*.

■ FIVE ORG-CHART PROGRAMS

Even though organization charts are a necessary communications tool, creating one is an elaborate and painstaking chore—unless you have the right tool. We test five programs and unfortunately find only two that we can recommend.



■ WOULD YOU RECOMMEND THIS PC TO A FRIEND?

Home PCs are a unique breed. The selling point is not power, but ease of use. And if it's not bundled with software already installed on the machine, the typical new user may not get past the C:\> prompt. In this review, we tell you whether any of the machines that are designed for the home user are worth recommending. ■

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BONUS includes a complete copy of GeoWorks Ensemble 1.0

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CIRCLE 183 ON READER SERVICE CARD

After Hours

Products for the Leisure Side of Personal Computing

Can't Get There from Here? Automap Shows You the Road Less Traveled

TRAVEL
by Jonathan Mazzon

If you've ever been hopelessly lost in the middle of a long car trip, you know the meaning of frustration. The situation only gets worse as you find a gas station, buy a road map from a surly attendant, and try to make some sense of the spaghetti-like lines and mysterious symbols that are supposed to help you figure out where you are going. Let's not even *talk* about refolding the map.

Automap ($99.95), from Automap Inc., is an attempt to prevent such travails by calculating, displaying, and printing clear, concise instructions that will take you smoothly from here to there. The software's extensive database of map, road, and location information requires about 4MB of hard disk space, and it works with a wide variety of monochrome and color graphics adapters, making it a suitable application for today's laptops.

Automap is somewhat similar to Klynas Engineering's *Streets On A Disk* ($225) in its routing function, but it doesn't offer *Streets'* other main functions. *Streets* can be used to overlay maps with details of infrastructure such as pipelines, phone lines, or sales territories, and it also displays mailing list information by street address. Separate *Streets* map modules are available at $100 to $225 for each U.S. county; a U.S. highway map costs $200. Klynas Engineering promotes *Streets* as a business tool.

Automap, on the other hand, comes with a built-in map of the entire country and is designed to generate directions for travelers. *Automap*'s database does include quite a bit of other geographically oriented information, though. For example, the locations of national parks, monuments, and recreation areas can be overlaid onto the map.

After you go through *Automap*'s simple initial configuration process, the program displays a map of the 48 contiguous United States. A number of major cities are labeled, and each state has a small icon that you can click on to get a summary of geographical information and other data of interest to motorists.

The simplest way to calculate a route is by pulling down the Screen menu from the menu bar at the top of the map screen and then selecting the Journey menu choice. *Automap* prompts you to fill in a simple template with your starting point, destination, and up to four intermediate destinations. The software's database offers a wide selection of towns—some of them quite small—including Wilmington, Vermont, and Croton-on-Hudson, New York, my hometown.

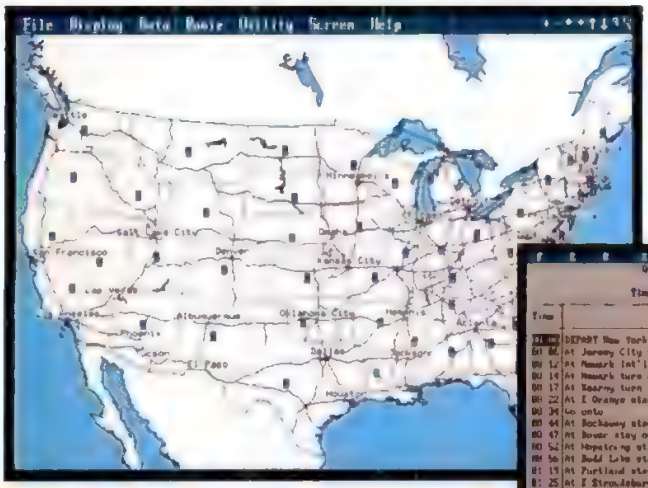
Once you've told *Automap* your starting and ending points, the program asks you whether you want the quickest route, the shortest route, any alternate routes, or all three. For each calculated route, *Automap* constructs a table of instructions that tells you which roads to take, how long to travel on each road, and the approximate time that each leg of the journey should take. The table also specifies intermediate points that each leg will take you through, and tells you which direction you are traveling in during each segment of your trip.

Selecting Map from the Screen pull-down menu redisplays the main map, and a blinking line traces your calculated route. You can use the map's zoom feature to get a closer look at your travel plans; for short trips, *Automap* automatically displays a zoomed portion of the map. Both the tables of directions and the route maps can be printed. The map expands to include trips to major Canadian

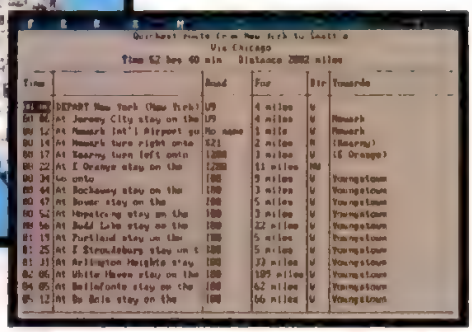
CONTINUES

- **TRAVEL**
  Automap lets you beat the traffic
- **HOBBIES**
  Gardenview
  Plant your own garden without getting your hands dirty
- **PUZZLES**
  With *Electric Jigsaw* and *Mickey's Jigsaw Puzzle*, you'll never have to worry about losing puzzle pieces

  Picture Puzzle
  Make your own puzzles from PCX files.



Automap's main map (shown above) displays 48 states. The program can overlay useful data such as the locations of national parks.



After computing a route, *Automap* displays a table of concise directions (below) that breaks your trip down into a series of legs.

Automap

CONTINUED

cities and Alaska, but Mexico and its roads are not supported.

You can graphically specify starting and destination points by clicking on the main map with the mouse. At EGA resolution, this proved difficult unless the zoom feature was used to enlarge the targets for the mouse cursor.

More unsettling than that minor shortcoming was the inefficiency of some of *Automap*'s routes. *Automap* calculated a route with an estimated elapsed time of over one hour to go from Croton-on-Hudson to Ossining, New York (an adjacent town); in reality, this trip takes about five minutes. *Automap*'s proposed "shortest" route would take a motorist on a circuitous route that begins by sending the hapless driver in the opposite direction from the intended destination. A number of other, relatively short trips were similarly inefficient in their routes.

Other trips were surprisingly well laid out. In plotting a trip from Milford, Connecticut to Smithtown, Long Island (New York), the program wisely took the availability of a local ferry into account. Automap Inc. explains that the program has trouble connecting small towns to the interstate highway system if there isn't at least a county road going through the vicinity. Longer trips were more efficiently planned. A trip from New York City to Seattle, via Chicago, proved to be efficiently planned and described.

Automap's interface and graphics are both first rate, as is the thorough, lucidly written documentation. *Automap* is most of the way there, but the programmers must come up with a way to deal with the tangle of local roads that link America's small towns.

List Price: *Automap*, $99.95.
Requires: 512K RAM, 4MB hard disk space, graphics adapter, DOS 2.2 or later.
Automap Inc., 9831 South 51st St., Bldg. C-113, Phoenix, AZ 85044; 602-893-2400.

CIRCLE 606 ON READER SERVICE CARD

How Does Your Garden Grow? With Silver Bells And Mouse Button Clicks

HOBBIES
by Don Trivette

Unless you have the green thumb of Mary Quite Contrary, you may not know how your garden will look until it bursts forth in bloom. To the rescue comes *Gardenview*, a CAD program from Mindsun for serious gardeners and landscapers.

With your mouse, you plant a garden by selecting plants from a database of 450 of the most common flowers, shrubs, and trees. The list includes roses, bellflowers, bearded iris, dill, yucca, and dogwood. For each plant the database includes the common name, the scientific name, the USDA zone number, and growing information such as height, spread, propensity to reproduce naturally, moisture requirements, sunlight, and half a dozen other factors. Paving and ground-cover materials like brick, sand, soil, grass, and water are included in the database.

Once you've completed a garden plan, *Gardenview* can construct perspectives of how the garden will look on any date. In winter the plot will be mostly brown, but as April approaches plants sprout from the ground and color begins to show. By June my garden was in full bloom. By setting date limits (say March 1 to November 1) and an interval value (2 weeks), you can watch the computer cycle your garden through an entire growing season. You can even cycle through years to see how self-seeding plants will reproduce and whether the sedum will shade out the phlox.

Should you forget the name of a plant, clicking on it brings forth an identifier. You can also ask for a plant key to be displayed below the perspective, and there are ways to save and print onscreen gardens.

Gardenview nearly suffers from too many options. You can specify your exact location (elevation, coordinates, and magnification) when viewing the garden; you can also set the heading and azimuth of the sun. Another feature lets you select two successive plantings, so when the pansies die out, you're ready to replace them with vinca. Advanced features let you create a garden with three-dimensional topography and add plants and materials to the database.

The bad news is that the *Gardenview* interface is cumbersome and poorly designed. When selecting a plant from the database, you must type the first few characters of its name to learn its index number, then return through the main menu to the planting command and manually enter that plant number. I was also disappointed in the graphic detail shown in the plants. I wanted to see leaves and petals instead of masses of color, but the programmers at Mindsun said that they did the best they could within the limits of enhanced VGA resolution.

***Gardenview's* graphics show limited detail. Pictured here is a perspective of a Japanese garden with a plant key at bottom.**

Gardenview's saving grace is that it is the only software of its type around; no one else seems to be writing landscape programs. With a bit of patience—something gardeners are prone to have anyway—you can indeed see how your garden grows without ever lifting a trowel.

List Price: *Gardenview*, $195.
Requires: 640K RAM, EGA or VGA monitor, mouse; 286 processor, math coprocessor recommended, DOS 2.1 or later. Mindsun, RD 2, Box 710, Andover, NJ 07821; 201-398-9557.

CIRCLE 607 ON READER SERVICE CARD

Jigsaws on Your PC, No Pieces on Your Floor

PUZZLES
by Don Trivette

Two new jigsaws—one from Disney, the other from Merit Software—will entertain puzzle fans for hours. Although one is geared to children and the other to adults, both have state-of-the-art user interfaces, dazzling graphics, and lively animations.

Mickey's Jigsaw Puzzles comes with fifteen pictures of various Disney characters in a variety of situations: Mickey in space, Minnie playing tennis, and Mickey and Minnie riding off into the sunset, to name a few. To ensure the highest quality graphics, the developers include separate picture files for each video type (Tandy, CGA, EGA, and VGA) rather than manipu-

CONTINUES

Jigsaw Puzzles

CONTINUED

lating the resolution of a single picture. There's an option for inputting additional puzzles, although Disney hadn't announced any new ones at the time of this writing.

The folks at Disney included some nifty features to ensure that children as young as five will be able to play and enjoy *Mickey's Jigsaw Puzzles*. Choosing the silhouette option—the easiest level—removes about a dozen dominant features from a given puzzle but leaves the background intact. For example, in the puzzle where Mickey, Donald Duck, and Goofy explore a dungeon in a haunted castle, the missing pieces of the puzzle include a ghost, a pair of eyes, the entire picture of Mickey, and each of Goofy's shoes. It's immediately apparent where each piece fits into the background. Even three-year-olds can figure out this level.

There are several options that allow you to make puzzles more challenging for older children and adults. You may cut a puzzle into 4, 9, 16, 25, 36, 49, or 64 pieces and specify traditional interlocking jigsaw shapes or the more difficult rectangular shapes. Another option lets you turn off the grid that outlines the shapes of the pieces. At its most difficult level—64 rectangles with no helpful grid—*Mickey's Jigsaw Puzzles* becomes an adult challenge.

The user interface shows careful planning and design. Although the game can be played with a joystick or by using the keyboard, you'll want a mouse. Click the right button and a puzzle piece appears under an icon of Mickey's hand; guide it to the proper location, click either mouse button, and it falls into place—even if it's the wrong place. There's no visual or audible indication to tell you whether a piece is correctly located, and that is one of my few criticisms. If you don't want the next piece randomly selected, you can pick your own from a "pieces" screen.

Bowing to popular requests, the Disney people have released *MJP* without password protection (which in the past had the unintentional effect of making some games childproof). Music and voices spill from the optional Disney Sound Source or the Sound Blaster card, and once the picture is completed there is a fun little animated sequence, which, I discovered, is more appealing to adults familiar with cardboard jigsaws than to children, who take it for granted. There is no Save feature since each puzzle can be completed in less than 20 minutes.

Sailboats, ancient ruins, a world map, a Ferrari, pets, and a haunted castle are *Electric Jigsaw*'s 6 picture choices. Although there is no option for inputting additional picture files, each of these 6 pictures can be cut in 16 different ways, ranging from 6 to a whopping 294 pieces. If you think a computer jigsaw can't match the cardboard kind in difficulty, just try putting 294 flashing pieces together to make a haunted castle in a thunderstorm.

The *Electronic Jigsaw* interface is superb. It is exactly like playing on a kitchen table, with one exception: The pieces never rotate, so if there is a straight edge across the top, you know that piece belongs on the top border.

Across the bottom of *EJ*'s screen is a window containing all the puzzle pieces without their distinctive shapes. This window reservoir is indispensable for locating pieces of similar hues and moving them to the puzzle.

When two pieces fit together, there is a pleasing click and a brief visual cue. Groups of pieces may be moved around and placed anywhere on the screen—even covering and hiding other pieces if you aren't careful.

Like the Disney product, *Electric Jigsaw* can be played with keyboard or joystick, but you'll go crazy moving 200 pieces around with anything but a mouse. It takes hours to solve a jigsaw cut into hundreds of pieces, so *EJ* incorporates an automatic Save feature. There are no voices and music is limited to the PC's speaker. The animation, while less ambitious than Disney's, is active even when the puzzle is in individual pieces.

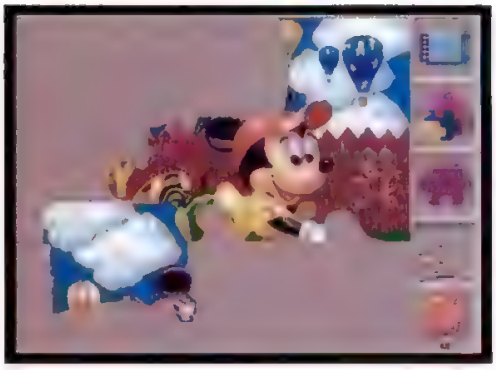
There's no better way to introduce a child to jigsaw puzzles than *Mickey's Jigsaw Puzzles*. It's an outstanding product that teaches children to use shapes, colors, and organization. *Electric Jigsaw* is an equally fine product and, at less than $20, a true software bargain. With its greater number of pieces, *EJ* proves challenging for older children, teens, and adults. It has a permanent place on my hard disk.

List Price: *Mickey's Jigsaw Puzzles*, $49.95. **Requires:** 512K RAM (640K for 256-color VGA), DOS 2.1 or later; mouse recommended. Disney Software, 500 S. Buena Vista Street, Burbank, CA 91521; 818-841-3326.

CIRCLE 608 ON READER SERVICE CARD

List Price: *Electric Jigsaw*, $14.95 ($17.95 for 3.5-inch disks). **Requires:** 640K RAM, DOS 2.0 or later; mouse recommended. Merit Software, 13635 Gamma Rd., Dallas, TX 75244; 214-385-2353.

CIRCLE 609 ON READER SERVICE CARD



With its simple shapes and Disney characters, *Mickey's Jigsaw Puzzles* is an ideal game and learning tool for small children.

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CIRCLE 335 ON READER SERVICE CARD

Low-Cost Puzzle Package Seems Simple but Provides Fun Challenge

Most computer games these days are either tests of hand/eye coordination or lengthy adventure games that you need days to wade through. If you crave mental challenges that you or your kids can conquer in one sitting, consider Software Creations' *Picture Puzzle*, a $15 shareware game.

Picture Puzzle takes a graphics screen and splits it into a jumbled rectangular grid that can have from 4 to 1,400 pieces. Using your mouse or cursor, you have to set it right again.

The program requires EGA or higher graphics and supports only 640 by 350 pixels with 16 colors. The program comes with 13 puzzles in its native PUZ format; a deluxe version contains 43. A few of the supplied PUZ files are somewhat grainy scans, but most are stunning original art by Gary Sirois.

Sound effects include a little tune of victory when you finish. The special effects and easy 4-by-4 puzzles meant my five-year-old had a ball, while more complex puzzles caught the fancy of my older children.

You can load any .PCX or .GIF files into *Picture Puzzle* as long as they do not have too many colors, but these puzzles proved to be less fun; the lack of any rescaling meant that only a partial screen display was possible.

If you are willing to work at it, though, you can create your own puzzles by scanning images or creating them in another package. ■

List Price: *Picture Puzzle*, Version 1.3, $15 (plus $2 shipping and handling); deluxe version with extra puzzles, $45 (plus $4 shipping and handling). **Requires:** 640K RAM, EGA or VGA graphics, DOS 3.0 or later. Software Creations, 26 Harris St., Clinton, MA 01510; 508-365-2359.

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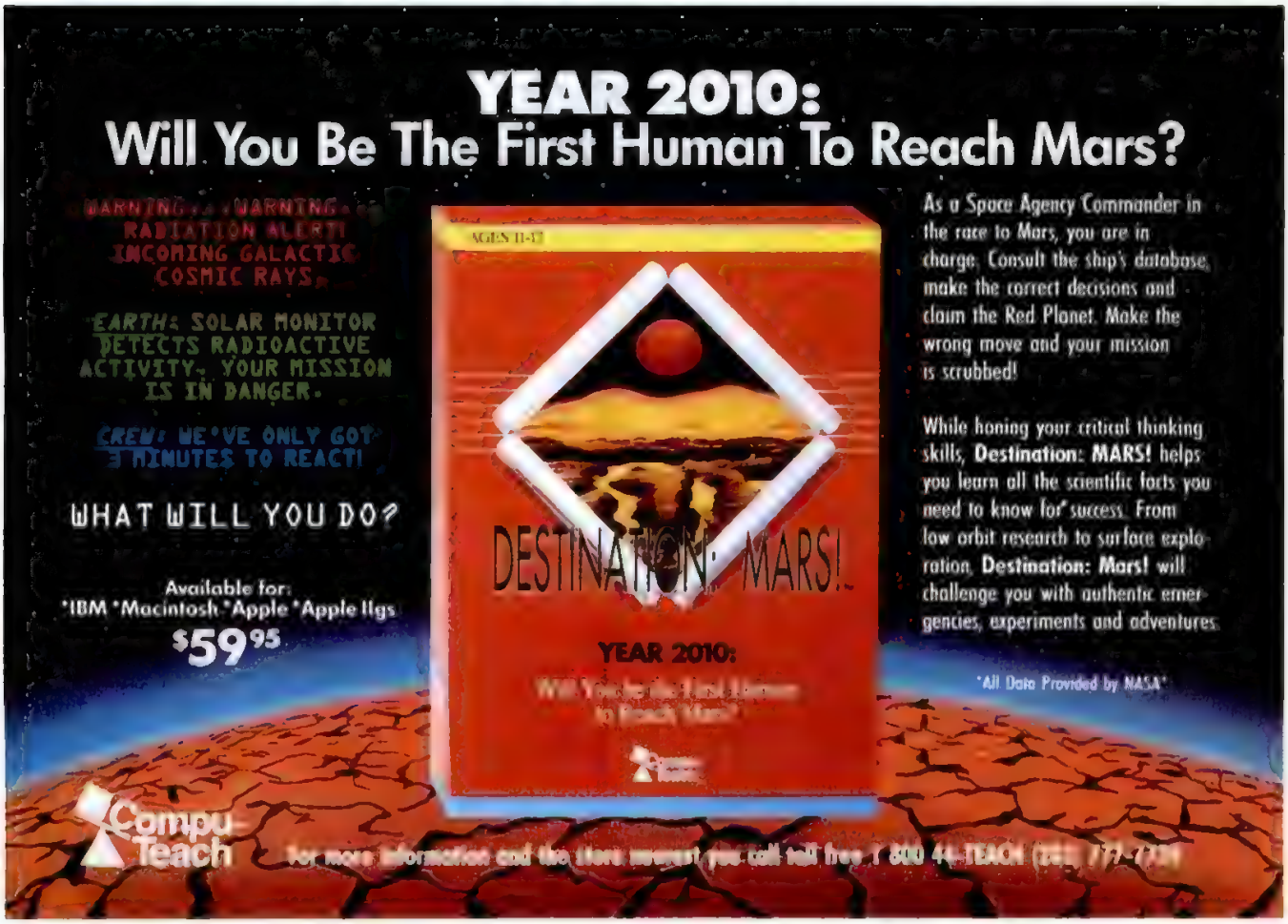
***Picture Puzzle* will let you see the completed picture in a pop-up box shown here in the lower-right-hand corner.**



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by Bill Howard

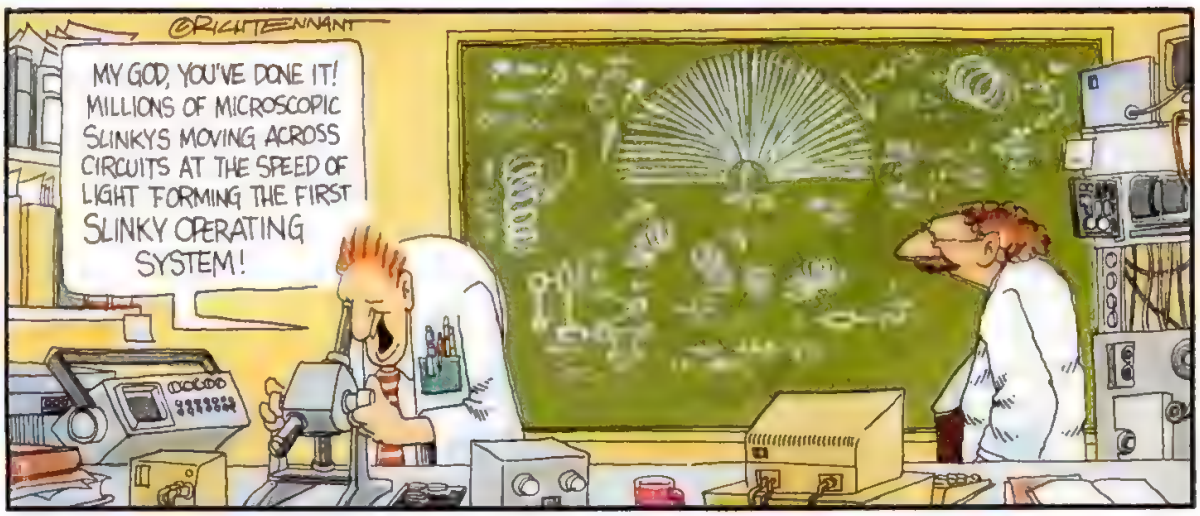
Abort, Retry, Fail?

The Lighter Side of Personal Computing

Ad from Hippo's, an Albany, NY, electronics dealer.

With the proliferation of chip types and speeds, maybe there is a 286SX, like the one advertised by Warehouse Club in the Chicago area.

This Ricoh fax machine operates at "9600 bauds per second," according to the COMB mail order catalog.



CARTOON: RICHARD TENNANT

If your entry is used in Abort, Retry, Fail? we'll send you $50 and a *PC Magazine* T-shirt. Caution: In case of multiple entries, the postmark date, neatness, and completeness of each entry are considered. Winners this issue: Michael Heath (keyboard wrist rest), Bruce Bagamery (9600 bauds per second), Robert J. Grant (car stereo, 3.5" floppy drive), Kyong I. Lee (286SX computer).

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3. If for resale, please identify your primary customers:
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4. How many PCs does your company plan to purchase in the next twelve months?

Quantity	Timeframe	Quantity	Timeframe
_____	Less than 1 month	_____	6-12 months
_____	1-3 months	_____	More than 12 months
_____	3-6 months		

5. What do you plan to use computer products for?

_____

_____

_____

6. How many PCs do you have installed now at your company?

_____

7. Are you interested in leasing? ☐ Yes ☐ No

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1. Which products are you most interested in?
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   ☐ i386-based systems ☐ Laptops/Notebooks
   ☐ i486™SX-based systems ☐ Other: _____
2. Are you interested in computer products for:
   ☐ Home ☐ Business ☐ Resale
3. If for resale, please identify your primary customers:
   ☐ General Business ☐ Government ☐ Education ☐ Medical
4. How many PCs does your company plan to purchase in the next twelve months?

Quantity	Timeframe	Quantity	Timeframe
_____	Less than 1 month	_____	6-12 months
_____	1-3 months	_____	More than 12 months
_____	3-6 months		

5. What do you plan to use computer products for?

_____

_____

_____

6. How many PCs do you have installed now at your company?

_____

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